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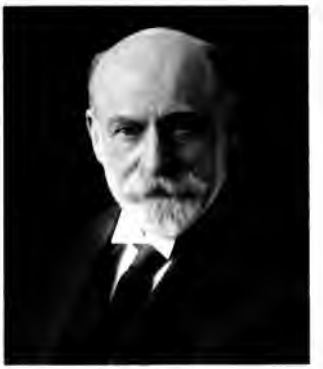
TABLES FOR THE DETERMINATION OF MINERALS

FRAZER AND BROWN

SIXTH EDITION



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TABLES

FOR THE

DETERMINATION OF MINERALS

BY

PHYSICAL PROPERTIES

ASCERTAINABLE WITH THE AID OF A FEW FIELD INSTRUMENTS

BASED ON THE SYSTEM OF THE LATE

PROFESSOR DOCTOR ALBIN WEISBACH

Austin F. Rogers.

BY

PERSIFOR FRAZER

DOCTEUR ÈS-SCIENCES NATURELLES; OFFICIER DE L'INSTRUCTION PUBLIQUE (FRANCE); PROFESSOR OF CHEMISTRY, PENNSYLVANIA HORTICULTURAL SOCIETY; CORRESPONDENT DER REICHSANSTALT ZU WIEN; VICE-PRESIDENT FOURTH AND SEVENTH INTERNATIONAL GEOLOGICAL CONGRESSES; HONORARY MEMBER OF THE SOCIETÉ GÉOLOGIQUE DE BELGIQUE; LIFE MEMBER AM. INST. M.E.; ACAD. OF NAT. SCI.; B.A.A.S.; LIFE FELLOW A.A.A.S., G.S.A., ETC.

AND

AMOS PEASLEE BROWN

PROFESSOR OF MINERALOGY AND GEOLOGY, UNIVERSITY OF PENNSYLVANIA; DOCTOR OF PHILOSOPHY (U. P.); LIFE FELLOW OF THE GEOLOGICAL SOCIETY OF AMERICA, AND FELLOW OF THE A.A.A.S.; MEMBER OF THE AMERICAN PHILOSOPHICAL SOCIETY, ACADEMY OF NATURAL SCIENCES; LIFE MEMBER OF THE AMERICAN INSTITUTE OF MINING ENGINEERS, ETC.

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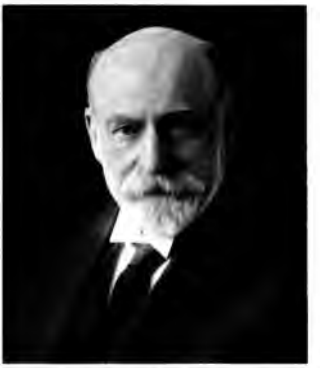

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INTRODUCTION TO THE FIRST EDITION

(1874)

* * * * * * * * * * * * *

EVERY one who has had the good fortune to study at the Royal Saxon Mining Academy, in Freiberg, will bear witness to the efficacy of the system there pursued for instructing young students in the art of distinguishing mineral species on the spot, by the aid of a tolerable memory and an intelligent observation of a few of their most striking physical properties.

* * * * * * * * * * * * *

No tables based upon purely physical properties can enable one to identify *all* species; though the greater one's experience in the field, the fewer minerals will require a laboratory investigation.

There are three applications for which these tables were more particularly designed:

The first is in the class-room, as an artificial memory to the student practising instantaneous determination; the second is for the prospector, geologist, or mineralogist in the field, as an occasional reminder of some point which was escaping his attention, and to suggest the simplest methods of discovering the identity of minerals if the physical tests fail; and third, they may prove serviceable to him who, though neither geologist nor mineralogist, is impelled by business or love of nature to collect minerals.

In America mineralogists have very generally agreed to consider Dana's last edition as authority on most disputed questions, and in nothing does this great work more clearly show the incredible industry, care, and good judgment of its author than in the considerations which have influenced him in regard to the choice of names for minerals. He has given to this essential though less professional part of the subject so much thought, has weighed so fairly and justly the claims of rival claimants to the right of naming, and has altered objectionable names with such independence and ability, that it would be strange indeed if an American book on any branch of the subject did not make Dana's nomenclature the basis of its own. This has been done in the present tables.

Every true mineral is a definite chemical compound, or element, homogeneous throughout its parts, and capable of expression in a formula which represents—at least—the proportion in which the atoms of the same or different elements are associated together in its molecule.

Its molecule is a distinctive whole,—the unit of its mass,—and incapable of division so long as the mineral retains its characteristic properties; and any formula which represents the mineral as consisting of two compounds is in antagonism with this fundamental principle, and can convey no clear idea of unity to the mind.

Starting with these postulates, as soon as I had decided to add a column of formulas to the tables, I determined to try, to the best of my ability, to reconcile the most reliable records of analysis with it, and if possible, in the light of the modern chemistry, to push this effort beyond mere empirical percentages to the construction of rational formulas. * * *

It is understood, of course, that what I have said as to the exclusion of the sign + from the formulas of minerals has no reference to the molecules of water, which always accompany crystallization in certain minerals; nor have I deemed it necessary to indicate this water by the symbol aq., for the reason that + 6aq., or + 12aq., seems inconsistent with a pure chemical notation. * * *

PREFACE TO THE SECOND EDITION

(1877)

It is with great satisfaction that I note in the lately issued "Text-Book of Mineralogy by Mr. E. S. Dana, on the plan and with the co-operation of Professor James D. Dana" (New York, Wiley, 1877), that the principle which must govern the construction of mineral formulas,—*i.e.*, the unity of the mineral molecule,—and which I so strongly emphasized in the preface to the first edition, finds abundant recognition throughout. Not indeed everywhere, and not in the form of rational, but generally in that of empirical formulas: yet this latter form of stating the constituents of a mineral seems vastly preferable to that of separate compounds united by the sign plus (+). It cannot be doubted, either, that until we are more advanced in our knowledge of the conditions affecting the existence of the gaseous, the liquid, and more especially the solid molecule, the safest method of writing a mineral formula is the empirical. But who would shut his eyes to the lines of order which rational formulas point out, imperfect though they be?

PREFACE TO THE THIRD EDITION

(1891)

THE first edition of this work was meant to be an English translation, with improvements earning for it the right to be considered a new edition, of the "Tabellen zur Bestimmung der Mineralien," by Professor Dr. Albin Weisbach; but before it was fairly commenced I saw that it would have to be modified in many particulars in order to meet the wants of American readers. The changes and additions were so numerous as to make virtually a new book, in which, however, the general plan sketched by Dr. Weisbach was followed. The Freiberg school in the hands of Werner and Breithaupt was essentially the physical school of mineralogy, great attention being paid to outward characteristics, and especially to crystal system and form. Even at the time of the publication of the first edition of these tables no account was taken in Freiberg of the great progress in the science of chemistry, but the formulas of minerals were written in the style of the unfortunate reaction from the lucid views of Berzelius, with the symbol for the water molecule HO. This was why the present writer felt it important to calculate the chemical formulas of minerals in the first edition of this work according to the light of the "new"—really the old—chemical theory, and he believes that it was the first time that this had been done in this country.

It will appear, from the fragment of the preface to the first edition which is retained, that he did not presume that this effort would be successful in all cases; but, considering the fact that perhaps as much has been learned of minerals and of chemical theory relating to them since 1874 as had been acquired up to that date; and considering also the fact that in seeking for rational formulas out of a mass of analyses by different chemists, without the opportunity of practically testing his assumptions, he was groping in the dark, it is very gratifying to him to observe, that the most modern formulas by the masters of greatest authority agree in a large number of cases accurately with those presented in this book at that time. Still a greater number differ from his tentative formulas of 1874 only because of the additional and more accurate data concerning the respective minerals obtained since that date. He is also happy to note that the principle for which he then contended, of the unity of the mineral molecule, in opposition to the theory of Professor J. D. Dana, has been tacitly conceded by all modern writers, including Professor Dana himself.

In rewriting the tables from beginning to end at the present time it was clearly unnecessary to repeat the preliminary work in mineral formulas, which the writer had undertaken at a great disadvantage, because no authoritative references were to be had.

With a work at hand so universally accepted as that of Dr. P. Groth's "Tabellarische Uebersicht der Mineralien" the old formulas of the former edition of this work became superfluous, and were—it is true, somewhat regretfully—displaced to make room for their betters. Dr. Groth has been made the standard authority on crystal system and chemical formula throughout this work, though in the latter the order in which he has placed the elements in his formulas has been frequently changed to conform with the practice adopted in the earlier edition of placing the cathions as much as possible first and the anions last. * * *

A new departure has been made in some of the terms used in describing a mineral, not without considerable reflection. The English vocabulary of mineralogy lacks many words of great utility in describing minerals. "Eingesprengt" has been ren-

dered in other books "disseminated," or "diffused," but these words do not convey the picture to the mind of what is meant as well as "interspersed," which has been adopted in this work. "Muschlig," "schalig," and "schuppig" are rendered "conchoidal," "*shelly*," and "scaly" in the following pages. "Säulig" and "stänglig" are given as "columnar" and "stalky." The latter word is somewhat barbarous, but is believed to convey the idea as well as "stem-like," besides being shorter.

One who contends for elegant diction may be shocked to see Erythrite described as "warty," but the figure is graphic if homely. The greatest difficulty in choosing terms as equivalents was experienced when "broad stalky," "short stalky," "fine reniform," etc., were required. There was no help for it, however, short of periphrasis, which would have added to the size of the book without other advantages than euphony, and this, whether or not wisely, was thought an insufficient one. * * * * *

The historical part of the table [of elements] is taken from a printed sheet prepared many years ago by the writer for his chemical class in the Franklin Institute.

Following the excellent plan of Weisbach's new table, notes as to the habit and structure of minerals have been added in the old column of "Crystal System," after the letters *H.* and *S.* respectively. The fracture has been appended to Cleavage, after the letters *Fr.* Under the column of "Remarks" are given the specific gravities ("G."), the chemical tests, etc., and the minerals associated with the species described ("A."). * * *

I wish to acknowledge my indebtedness for suggestions to Mr. C. Bement, Professor H. B. Cornwall, Professor Wolcott Gibbs, William Crookes, F.R.S., P.P.C.S., and very especially to Professor F. W. Clarke.

PHILADELPHIA, 1891.

PREFACE TO THE FOURTH EDITION

(1896)

More use than formerly has been made of the numbers in the scale of fusibility. Such numbers, except when it is otherwise specified, refer to von Kobell's scale, given on page 120. * * *

P. F.

November, 1896.

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ABBREVIATIONS

ac acicular, acid
acu acute
adm adamantine
am amorphous
amn ammonia
ang angular
argil argillaceous
art artificial
astring astringent
az azure
BB before the blowpipe
bas basal
bit bitter
blk black
blu blue
bluh bluish
bot botryoidal
brec brecciated
brit brittle
brn brown
brnh brownish
brnz bronze
but button
can candle
cap capillary
ch charcoal
choc chocolate
clm columnar
clss colorless
clv cleavage
cmn common
cnch conchoidal
comp compact
cop copper
crxl cryptocrystalline
ctg coating
cub cubic
cyln cylindrical
decomp decomposed-es-ing
decrep decrepitates
deflag deflagrates
den dendritic
dir direction
dissem disseminated
dist distinct
dk dark
dodl dodecahedral
dsto distorted
duct ductile
effervesc effervesces-ing, etc.
elas elastic
elng elongated
emin eminent
emld emerald
ethy earthy
exfol exfoliates
fib fibrous
fl flame
flx flexible
fn-gr fine-grained
fnly finely
fol foliated
fr fracture
frgs fragments
fus fusible
gen general-ly, etc.
gltg glinting
gran granular
grn green
grnh greenish
gry gray
gryh grayish
H habit
hex hexagonal
hly highly
hmhd hemihedral
hmph hemimorphic
holh holohedral
hxdl hexahedral
icst icositetrahedral

imp imperfect
incr incrustation
inds indistinct
infus infusible
insol insoluble
insp interspersed
ism isometric
lam lamellar
lent lenticular
lngt longitudinal-ly
lt light
lvndr lavender
magn magnetic
mal malleable
masv massive
mcl monoclinic
mcrc microcosmic (salt)
met metallic
mic micaceous
m. o. p. mother-of-pearl
mtdl metalloidal
nitr nitric
nod nodular
obs observable
obt obtuse
oc occasionally
ochr ocher
octl octahedral
octn octahedron
opq opaque
orcl orthoclase
orm orthorhombic
part particles
perf perfect
pl pale
plch pleochroic
plcm pleochroism
powd powdery
precip precipitate
prly pearly
prmc prismatic
prsm prism
psdm pseudomorph
pulv pulverulent
pungt pungent
pyrl pyramidal
pyrt pyritohedral
r plus unit rhombohedron
rd red
rdl radial
rdsh reddish
reac reaction-s, etc.
refrac refraction-ive, etc.
res resinous
ret reticulated
rtr rather
rhdl rhombohedral
rhdn rhombohedron
rnd rounded
rnfm reniform
S structure
satn satin
sbcn subconchoidal
scy scaly
sclh scalenohedral
sect sectile
seld seldom
sep separate, separation
shly shelly
silv silvery
slky silky
sm small
smts sometimes
smwh somewhat
sol soluble, solution
sphl spheroidal
spln splintery
stal stalactitic
stel stellate
stky stalky
stl steel
subl sublimate, sublimes
subst substance
sulph sulphur-ic, etc.
surf surface
tab tabular
tetr tetrahedral
tol tolerably
tr trace
trcl triclinic
trig trigonal
trnc truncated
trnsh tarnish-ed
trpz trapezohedral
trsl translucent
trsm transmitted

trsp transparent
ttar tetartohedral
ttrg tetragonal
unct unctuous
unvn uneven
vilt violet
vitr vitreous
vol volatile, volatilizes
vrdg verdigris
wh white
wrty warty
xl crystal
xln crystalline
yel yellow
yelh yellowish

CRYSTALLOGRAPHIC SYMBOLS

(111), octahedron, unit pyramid.
(110), dodecahedron, unit prism.
(100), cube, second order prism, macropinacoid, orthopinacoid.
(101), second order pyramid, macrodome, orthodome.
(011), brachydome, clinodome.
(010), brachypinacoid, clinopinacoid.
(001), basal pinacoid.
$(10\bar{1}0)$, hexagonal prism of first order.
$(11\bar{2}0)$, " " of second order.
$(10\bar{1}1)$, hexagonal pyramid.
(0001), basal pinacoid.

TABLES

FOR THE

DETERMINATION OF MINERALS

I MINERALS OF

1

Name	Color	Streak	Hardns	Tenacity
Copper	copper-red	copper-red	2.75	malleable
Bornite (Buntkupferkies, Erubescite)	copper-rd to brnz-yel	black	3.50	sect to brittl
Niccolite (Arsennickel, Rothnickelkies)	lt copper-red	brownish-black	5.25	brittle
Melonite	rdsh-white	dark gray	.....	.....
Breithauptite (Antimonnickel)	copper-red vilt hue	red-brown	5.5	brittle

2

METALLIC LUSTRE

Red

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* octl, cub, dodl *S.* masv, insp, ctg, in sheets, lam, wiry	*Fr.* hackly	Cu (oc with Ag, As, Sb, Bi, etc)	G. 8.9. BB *ch.* easily fus, on cooling covered with blk oxide. Sol in nitr ac, giving red fumes and penetrating odor; deep blue on addition of amn. *A.* In beds and veins usually near igneous rocks.
Ism *H.* cub, dodl *S.* masv, insp	.....	Cu_2FeS_2	G. ± 5.0. Cop-col fresh fract. BB fus to brit magn globule. Sol in nitr ac, with sep of S. *A.* Chalcopyrite, Malachite, Chalcocite.
Hex *H.* obt pyrl *S.* masv, insp	.....	NiAs (oc with Fe, Co, Sb, and S)	G. 7.5. Xls rare. BB *ch.* As fumes. Fus to but. *A.* Chloanthite, Smaltite, Bismuth, Silver Arsenic Barite, Fluorite.
Hex *H.* gran, fol	.....	Ni_2Te_2	G. 7.5.
Hex *H.* thin tab *S.* insp	.....	NiSb (oc with galena and tr Fe)	G. 7.5. Weathers reddish-blue. BB like Niccolite, but with reac for Sb in place of As. *A.* Chloanthite, Galenite, Blende, Calcite.

2

Name	Color	Streak	Hardns	Tenacity
Sternbergite (Silberkies, in part)	pinchbeck-brown bronze-yellow	black	1.5	sectile
Gold	gold-yellow	gold-yellow	2.5	malleable
Electrum	yellowish-white	yellowish-white	2.5	malleable
Calaverite	bronze-yellow	yelh-gray	2.5	brittle
Bornite (Buntkupferkies, Erubescite)	reddish pinchbeck-brown	greenish-black	3.5	brittle
Pentlandite	light brnz-yel	lt brnz-brn	3.75	brittle
Millerite (Gelbnickelkies, Haarkies)	speiss to bronze-yellow	black to bright	4	brittle
Chalcopyrite (Kupferkies, Copper Pyrites)	brass-yellow	green-black	4	sect to brit
Troilite	metallic	black	4	brittle
Pyrrhotite (Magnetkies)	bronze-yellow	black	4.5	brittle

Yellow

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *H.* scaly *S.* massive	*Clv.* basal *Fr.* short fib	$AgFe_2S_3$	G. 4.2. Gen brightly tarnished. BB fus to magn but on the surf of which separated met silver shows. Sol in aqua regia, with sep of S and AgCl. *A.* Pyrargyrite, Stephanite, Proustite, Arsenic, Barite.
Ism *H.* octl, cub, dodl *S.* insp, masv, lam, ctg	.....	Au (usually with Ag)	G. 15.6–19.5. Xls often deformed. BB fus easily to gold-yel but. Not sol in any single acid. *A.* Pyrite, Galenite, Blende, Arsenopyrite, Antimonite, Quartz.
Ism *H.* octl, cub *S.* insp, masv, lam, ctg	.....	$xAu+yAg$	G. 12.5–15.5. BB etc., see Gold and Silver. *A.* Pyrite.
H. massive	*Fr.* unvn	$(Au,Ag)Te_2$	G. 9.
Ism *H.* cub, dodl *S.* masv, insp	*Clv.* 111	Cu_3FeS_3	G. 5. Fresh surf after few hours tarnishing red, after longer time bluish-red, rdsh-blue, and blue. (See I 1.)
Ism, *S.* masv	*Clv.* 111	(Fe,Ni)S	G. 4.60, non-magn.
Hex *H.* rhdl, cap, ac *S.* masv, insp	*Clv.* R perf, *Fr.* fibrous	NiS (tr Fe and Cu)	G. 5. Usually in cap xls or radiating tufts. BB in open tube SO_2. Fus to a magn but. *A.* Chloanthite, Gersdorffite, Siderite, Barite, Fluorite.
Ttrg *H.* pyr, sphenoidal *S.* masv, insp, rnfm	*Clv.* 001 inds, 201 inds	$(Cu_2)S_2(Fe_2)S_2$	G. 4.2. In matrass decrep and yields S. In nitr ac grn sol with sep of S. Sol becomes blue on addition of amn. *A.* Malachite, Bornite, Tetrahedrite, Galenite, Blende, Pyrite, etc.
Massive	.....	FeS	G. ± 4.78.
Hex *H.* tab *S.* masv, insp	*Clv.* bas perf, prsm less so	$Fe_{11}S_{12}$	G. 4.5. In great part magn, frequently containing Ni. Xls rare. BB fus to black magn mass. O F red. *A.* Pyrite, Chalcopyrite, Galenite, etc., etc.

Name	Color	Streak	Hardns	Tenacity
Carrollite	light steel-gray	.....	5.5	brittle
Marcasite (Speerkies, Kammkies)	white speiss-yellow	black	6	brittle
Pyrite (Mundic, Schwefelkies, Eisenkies, Iron Pyrites)	pale brass-yellow	black	6.5	brittle

3

Mercury	tin-white	.....	liquid	.....
Sylvanite	tin-white	.....	.....	.....
Krennerite	silv-wh to brass-yel	.....	.....	brittle
Bismuth	silv-wh rdsh hue	gray	2.25	sect to brit
Tellurium	tin-white	gray	2.5	brit to sect
Hessite (Tellursilber-glanz)	lead-gry to stl-gy	gray	2.5	malleable
Silver	silver-white	silver-white	3	malleable

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism	*Fr.* subconch	$CuCo_2S_4$	G. 4.85
Orm *H.* tab, clm, pyrl *S.* rnfm, masv	*Clv.* 110 rtr perf *Fr.* fib, fn-gr, comp	FeS_2	G. 4.7. BB, etc., like Pyrite. *A.* Pyrite, Blende, Galenite, Arsenopyrite.
Ism *H.* cub, pyrt, octl *S.* rnfm, lumpy, masv, insp	*Clv.* 111 & 100 inds *Fr.* fn-gr, comp, fib	FeS_2	G. 5. In closed tube, subl of S and magn residue. *A.* Galenite, Blende, Arsenopyrite, Magnetite, Specularite, Siderite, etc.

White

Ism (in art xls)	.....	Hg (often with a little Ag)	G. 13.5. BB vol and condensing in drops.
.....	.....	.....	(See p. 12.)
Orm	*Clv.* 001, perf	Ag, Au, Te, Sb	G. 8.353.
Hex *H.* rhdl, *S.* insp, masv	*Clv.* bas perf 2021 less so	Bi	G. 9.7. Often brightly tarnished. Xls very rare. Melts in can fl. BB fus, vol. Xlizes on cooling. *A.* Smaltite, Chloanthite, Barite, Cassiterite, Wolframite, Molybdenite.
Hex *H.* rhdl, short ac *S.* masv, insp	*Clv.* 110 perf *Fr.* fn-gr	Te	G. 6.2. Melts in can fl. BB fus, vol, gives grn tinge to fl, and wh coat. *A.* Gold, Sylvanite.
Ism *S.* masv	*Clv.* inds *Fr.* fn-gr	Ag_2Te	G. 8.5. (Var Petzite, iron-blk,—brit. G=9,—contains Gold.) Melts in can fl. Tarnishes blk. BB R F fus and, cooling, shows wh, dendritic silver. *A.* Native Gold.
Ism *H.* hxdl, octl *S.* masv, insp, hackly, cap, lam, ctg, ret	.....	Ag	G. 10.5. Often tarnished yel, brn, or blk. Xls often deformed. BB fus easily to wh but. O F faint red ctg of oxide. Xlizes on cooling. Sol in HNO_3, precip by HCl. *A.* Argentite, Pyrargyrite, Proustite, Barite, Quarts.

Name	Color	Streak	Hardns	Tenacity
Amalgam (Arquerite, Kongsbergite)	silver-white	gray	3	brittle
Antimony	tin-white	gray	3	sect to brit
Domeykite (Arsenkupfer)	tin-wh to stl-gry	gray	3.25	brittle
Allemontite	tin-wh to rdsh-gray	gray	3.5	brittle
Dyscrasite (Antimonsilber)	silver-white	gray	3.5	sectile
Cubanite	brnz to brass-yel	rdsh-brnz to blk	4	brittle
Safflorite	tin-white	gryh-blk	4.75	brittle
Löllingite (Arsenikalkies, Pharmakopyrite)	tin-white	grayish-black	5	brittle
Smaltite (Chloantite, Weissnickelkies)	tin-white	gray	5	brittle
Gersdorffite (Graunickelkies, Arsennickelkies)	tin-wh to blu-gry	lead-gry to tin-wh	5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* dodl *S.* masv, insp, ctg	.....	(Ag, Hg)	G. 10.5–14. BB mercury vol, silver left. (See preceding.) *A.* Cinnabar.
Hex *H.* rhdl *S.* insp, masv	*Clv.* bas perf R and—½ R dist *Fr.* granular	Sb	G. 6.6. Xls very rare and small. Melts in can fl. BB fus, giving wh coat. When heat ceases the but continues to glow, giving wh fumes and crusting over with oxide. The wh coat colors the R F bluh grn. Xlizes from fus. *A.* Antimonite. Kermesite, Smaltite.
S. masv, insp	*Fr.* uneven	Cu_3As	G. 7.5. BB arsenic fumes and mal but of copper. Sol in HNO_3 but not in HCl. Algodonite (Cu_6As) and Whitneyite (Cu_9As) are allied species.
Hex. *H.* rhdl, rnfm, am	.....	$SbAs_3$	G. 6.203.
Orm *H.* clm, tab, obtuse pyr *S.* masv, insp	*Clv.* bas dist *Fr.* gran, unvn	Ag_3Sb	G. 9.5. Often tarnishes dark gray. Melts in can fl. BB fus to but, ctg coal with white antim ox and leaving pure silver. *A.* Galenite, Arsenic, Pyrargyrite, Silver, Smaltite.
Ism	*Clv.* cub	$CuFe_2S_4$	G. 4.05.
Orm	*Clv.* 010, dist	$CoAs_2$	G. 7.1.
Orm *H.* ac *S.* masv, insp	*Fr.* comp, fn-gran, stky, fib	$FeAs_2$	G. 6.8. Xls rare. Closed tube, subl of As. BB odor of As and magn but. *A.* Galenite, Blende, Pyrite, Magnetite, Cassiterite, Siderite.
Ism *H.* hxdl octl *S.* masv, insp, ret	*Fr.* comp, short fib, fn-gran	$(Co,Fe,Ni,)As_2$	G. 6.8. Often with apple-green ctg. In closed tube As. BB As odor, and fus to but containing Fe, Co, Ni. *A.* Niccolite, Bismuth, Proustite, Barite, Fluorite, Siderite.
Ism *H.* octl *S.* masv	*Clv.* cub, rtr perf	$(Ni,Fe)AsS$	G. 6. In closed tube decrep and deposits sulphide of arsenic. Decomp by HNO_3, with formation of grn sol and sep of S and As_2O_3. *A.* Niccolite Siderite.

Name	Color	Streak	Hardns	Tenacity
Glaucodot	gryh tin-wh	black	5	brittle
Linnæite (Kobaltkies)	red silver-white	grayish-black	5.25	brittle
Cobaltite (Kobaltglanz)	red silver-white	grayish-black	5.5	brittle
Arsenopyrite (Mispickel, Arsenkies)	tin-white	grayish-black	5.5	brittle
Ullmannite (Antimonnickel-kies)	tin-white	black	5.5	brittle
Rammelsbergite	tin-wh to rdsh	gray-black	5.75	brittle
Skutterudite (Tesseralkies)	tin-white	grayish-black	5.75	brittle
Sperrylite	tin-white	black	6.5	brittle
Iridosmine (Sisserskite) (Newjanskite)	tin-white	grayish-black	7	slightly mal to nearly brit

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm	*Clv.* 001 rtr perf	$(Co,Fe)_2(As,S)_2$	G. + 5.95.
Ism *H.* octl holh	.....	$(Ni,Co,Fe,)_3S_4$	G. ± 4.9. BB As and S odor. Fus to magn but. Sol in HNO_3 with sep of S. *A.* Chalcopyrite, Tetrahedrite. Siderite.
Ism *H.* hxdl, octl, dodl, hmhd *S.* masv, insp	*Clv.* cub perf *Fr.* gran	$(Co,Fe)AsS$	G. 6. BB gives off S and As and fus to magn but. Sol in warm HNO_3, sep arsenic oxide and sulph. *A.* Chalcopyrite, Pyrrhotite (Magnetopyrite), Molybdenite, Amphibole Pyroxene.
Orm *H.* clm, ac, tab, pyr *S.* masv, insp	*Clv.* 110 dist *Fr.* fn-gr, thin stky	$FeAsS$ or $Fe(As,S)_2$	G. 6. Xls deficient in facets. Often tarnished gray or bright. BB As odor. Gives magn but. Decomp by HNO_3, sep arsenic acid and S. *A.* Blende, Galenite, Chalcopyrite, Pyrite, Magnesite, Cassiterite.
Ism	*Clv.* cub perf	$NiSbS$	G. 6.3. Closed tube, faint wh subl. Open tube, S and Sb fumes, the latter condensing on the sides, and not vol. BB fus to but, boils and gives Sb vapors which coat coal. Decomp by HNO_3, forming grn sol, with sep of sulph and Sb ox. *A.* Galenite Chalcopyrite.
Orm	*Clv.* prsm	$(Ni,Co,Bi,Fe)(As,S)_2$	G. ± 7.
Ism *H.* octl *S.* masv	*Clv.* cub (dist)	$CoAs_2$	G. 6.7. In matrass subl of met As. Open tube wh fumes of arsen acid. BB As odor. Fus to but. *A.* Cobaltite and ores of Co, Ni, Cu, Ag.
Ism *H.* cub	*Fr.* cnch	$(Pt,Rh)(As,Sb)_2$	G. 10.6.
Hex *H.* rhdl, scaly	*Clv.* bas, perf	$x\text{Ir}+y\text{Os}$ (with Rd, Pt, Cu, Fe, Ru)	G. 19.3–21.12. BB infus. At high temp. Sisserskite gives off Os, but suffers no other change. Newjanskite gives no Os odor till fused with nitre. *A.* Gold and Platinum.

4

Name	Color	Streak	Hardns	Tenacity
Lead	lead-gray	lead-gray	1.5	mal, duct
Molybdenite (Molybdänglanz)	rdsh lead-gry	bluh-gry, lustrous	1.5	sect to mal
Nagyagite (Blättertellurerz)	blk lead-gry to iron-blk	grayish-black	1.5	sect to mal
Sylvanite (Schrifterz) (See p. 6.)	lt steel-gray	gray	2	sectile
Pyrolusite (Weichmanganerz)	dk steel-gry to lt iron-blk	black	2	sect to brit
Tetradymite (Tellurwismuth)	pl steel-gray to silver-white	dark gray	2	sect to mal
Joseite	grayish-black	.....	soft	fragile
Aikinite				
Jamesonite (Federerz)	blk lead-gry to steel-gry	gray-black	2.5	sect to brit

Gray

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism	.....	Pb(Ag,Sb)	G. 11.37.
Hex *H.* fn tab, scy *S.* insp, masv	*Clv.* basal perf *Fr.* thin shly	MoS_2	G. ± 4.6. Gray streak on paper and unglazed porcelain. Grnh streak on glazed porcelain. Unct to touch; cut by the nail. Laminæ flx but not elastic. BB yel-grn flm. In O F odor of SO_2 and coats coal with MoO_3. Yel hot; wh, cool, and red near subst. With intermittent flm az blue. Decomp by nitr ac with residue of MoO_3. *A.* Wolframite, Arsenopyrite, Cassiterite, Magnetite, Blende, Pyrite.
Orm *H.* fn tab, scy *S.* insp	*Clv.* bas perf	$Au_2Pb_{14}Sb_8(S,Te)_{24}$	G. 6.9. BB two coats, most distant wh and vol, that nearest subst yel. *A.* Blende, Tetrahedrite, Rhodocrosite, Sylvanite.
Mcl *H.* short ac, scy *S.* insp	*Clv.* 010 dist	$(Ag,Au)Te_2$	G. ± 8.15. In open tube wh subl, gray near subst, fusing BB to clear, trsp drops. *Ch.* fuses and gives white coat, which in R F disappears, giving bluh-grn color to flm. *A.* Tetrahedrite, Blende.
Orm (pseud) *H.* clm, ac, cap *S.* massive	*Fr.* stky, fib, gran	MnO_2 with 2 p c H_2O	G. 4.8. Blkens objects touched. BB infus. Loses oxygen. Gives Cl with HCl. *A.* Psilomelane, Barite.
Hex *H.* acute rhdl, scy, tab *S.* massive	*Clv.* bas perf	$Bi_2(Te,S)_3$	G. 7.2–7.9. Xls small. Melts in can fl. Laminæ flx. Marks paper. Open tube wh subl of tellur oxide, which BB fus to clss drops. *Ch.* fus, wh fumes, and entirely vol. Tinges R F bluh-grn. Coats first wh and then orange-yel. *A.* Gold.
H. lam	.....	Bi,Se,Te,S.	G. ± 7.93.
Orm *H.* ac, cap *S.* massive	*Clv.* bas dist *Fr.* stky, fib, comp	$Pb_2Sb_2S_5$	G. 5.7. Melts in can fl. Decrep, subl of Sb_2S_3. BB almost entirely vol, giving coat wh near outer edge, yel near assay. *A.* Galenite Bournonite.

Name	Color	Streak	Hardns	Tenacity
Stibnite (Antimonite) (Grauspiess-glaserz) (Antimonglanz)	lead-gray	grayish-black	2.5	sectile
Freieslebenite (Schilfglaserz)	steel-gray to black lead-gray	gray-black	2.5	sect to brit
Diaphorite	steel-gray to black lead-gray	gray-black	2.5	sect to brit
Argentite	black lead-gray	gray-blk, lustrous	2.5	malleable
Naumannite	iron-black	iron-black	2.5	.....
Bismuthinite (Wismuthglanz)	light steel-gray	black	2.5	sect. to brit
Clausthalite	lead-gray	grayish-black	2.5	sectile
Zinkenite (Bleiantimon-glanz)	lead-gray	grayish-black	2.5	sect to brit

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *H.* ac, tab, clm *S.* stky, fib, gran, comp	*Clv.* 010 hly perf. Clv planes often striated	Sb_2S_3	G. 4.5. Often tarnished in bright colors. Melts in can fl. Open tube S and Sb fumes, the latter not vol. BB *ch.* wh coat, coloring grnh-blue in RF. Sol in HCl. *A.* Siderite, Blende, Barite, Quartz, Pyrite, Gold.
Mcl *H.* short acic *S.* masv, insp	*Fr.* comp, fn-gr	$(Pb,Ag_2)_5Sb_4S_{11}$	G. ± 6.2. Melts in can fl. BB *ch.* coats wh on outer edge, yel near subst. R F silver but. *A.* Pyrargyrite, Barite, Siderite.
Orm	*Fr.* comp, fn-gr	$(Pb,Ag_2)_5Sb_4S_{11}$	G ± 6.2. Melts in can fl. BB *ch.* coats wh on outer edge, yel near subst. R F silver but. *A.* Pyrargyrite, Barite, Siderite.
Ism *H.* cub, octl, dodl *S.* masv, insp, ctg, lam, ret	.....	Ag_2S	G. 7.2. BB *ch.* fus with intumescence, emitting S fumes, and yielding Ag but. *A.* Pyrargyrite, Proustite, Silver, Galenite, Blende, Niccolite, Barite, Fluorite, Siderite.
Ism *H.* cub	*Clv.* cub perf	$(Ag_2,Pb)Se$	G. 8.
Orm *H.* cap, ac *S.* massive	*Clv.* 010 perf	Bi_2S_3	G. 6.4. Melts in can fl. In open tube S fumes and wh subl, which BB fus into drops. Brn when hot and opaque yel cold. *Ch.* fus, with spirting, and coats yel. Dissolves in nitr ac, and wh precip falls on diluting with water. *A.* Bismuth, Chalcopyrite, Gersdorffite, Siderite, Cassiterite, Wolframite, Molybdenite.
Ism *S.* insp, masv	*Clv.* cub perf *Fr.* fn-gr	PbSe	G. 7.6 to 8.8. BB decrep in closed tube. Open tube, selenous fumes and red subl. *Ch.* gray near subst, with red border; later, yel. Partially fus. Entirely vol. Resembles Galenite, but BB distinguish it. *A.* Gold.
Orm *H.* ac, clm *S.* massive	*Fr.* stalky	$PbSb_2S_4$	G. 5.3. Xls seem hex. Melts in can fl. Decrep and fus easily. BB almost entirely vol. Coat yel near subst, wh further off. Sol in hot HCl, evolving H_2S and precip $PbCl_2$ on cooling. Resembles Stibnite and Bournonite, but is harder and heavier. *A.* Galenite, Antimonite.

Name	Color	Streak	Hardns	Tenacity
Argyrodite*	steel-gray	gryh-blk, shining	2.5	smwh brit
Galenite (Bleiglanz)	reddish lead-gray	dark gray	2.75	sectile
Chalcocite (Kupferglanz)	black lead-gray	dark gray	2.75	sect to brit
Bournonite (Rädelerz)	steel-gry to iron-blk	grayish-black	2.75	brit to sect
Boulangerite	lead-gray	grayish-black	2.75	sect to brit
Tiemannite	lead-gray	grayish-black	2.75	sect to brit
Binnite	stl-gry to iron-blk	rdsh-brown	2.75	brittle
Petzite	stl-gry to iron-blk	.....	2.75	sect to brit
Stephanite (Brittle silver ore, Melanglanz)	blk lead-gry to iron-blk	grayish-black	2.75	sect to brit
Cosalite	lead to stl-gry	black	2.75	brittle
Cylindrite	blksh lead-gry	.....	2.75	.....

* Germanium was discovered in this mineral.

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism	.....	$3Ag_2S.GeS_2$	G. ± 6.1.
Ism *H.* cub, octl *S.* masv, insp, ctg, tab.	*Clv.* cub (perf) *Fr.* gran, comp, thin scaly, broad stky	PbS	G. 7.5. BB *ch.* coats coal yel and gives but of lead. Sol in nitr ac. *A.* Blende, Chalcopyrite, Pyrite, Barite, etc. In veins and beds.
Orm *H.* tab, short acic, obt pyrl *S.* masv, insp, tab	*Clv.* bas obs	Cu_2S	G. 5.7. BB yields nothing vol in closed tube. SO_2 in open tube. R F with soda met Cu. *A.* Chalcopyrite, Bornite, Tetrahedrite, Malachite, Pyrite Barite.
Orm *H.* tab, cuboid, obt pyrl *S.* masv, insp	.....	$Pb_2Cu_2Sb_2S_6$	G. 5.8. Xls seem ttrg. Multiple twin structure. Often cruciform. In closed tube, decrep and gives dk-red subl. BB *ch.* fus easily and coats wh outside and yel near subst. R F with soda, but of Cu. Decomp by nitr ac, leaving residue of S, and wh powder containing Sb, and Pb in blue sol. *A.* Tetrahedrite, Galenite, Chalcopyrite, Arsenopyrite Siderite Barite.
Orm *S.* massive	*Fr.* thin stky, fib, comp	$Pb_3Sb_2S_6$	G. 5.8. Melts in can fl. BB, see ZINCKENITE. *A.* Galenite Antimonite.
Ism *H.* tetr	.....	HgSe	G. 7.2. Decrep and subl in closed tube, giving blk subl, upper edge rdsh-brn. Open tube, odor of Se. Forms dk rdsh-brn subl, with border of wh Hg selenate. BB *ch.* vol, coloring outer flame az and leaving met ctg. *A.* Chalcopyrite.
Ism	*Fr.* cnch	Cu,As,S	G. 4.47.
? *H.* massive	*Fr.* subconch	$(Ag,Au)_2Te$	G. 9.
Orm *H.* tetr, thick tab, short and long clm *S.* masv, insp	.....	$Ag_{10}Sb_2S_8$	G. 6.2. Xls seem hex. Melts in can fl. BB *ch.* fus with spirting. Coats coal with Sb oxide, and gives but of Ag. Sol in dilute hot nitr ac, precip S and Sb oxide. *A.* Argentite, Silver Pyrargyrite, Barite.
Orm	*Fr.* unvn	$(PbBi)_2S_5$	G. 6.5.
.....	.....	$Pb_6Sb_2Sn_6S_{21}$	G. 5.55.

Name	Color	Streak	Hardns	Tenacity
Berthierite	lead-gry to dark steel-gry	grayish-black	3	brittle
Frenzelite (Guanajuatite)	bluish-gray	gray, shining	3	sectile
Dufrenoysite	blackish lead-gray	reddish-brown	3	very brittle
Miargyrite (Silberantimonglanz)	steel-gry to iron-blk	dark cherry-red	3	sect to brit
Arsenic	lead-gry to tin-wh	grayish-black	3.5	brit to sect
Tenorite	stl-gry to earthy	stl-gry to blk	3.5	.....
Tetrahedrite (Antimonfahlerz. Comn var)	dk steel-gry lead-gry iron-blk	blk in part, inclining to cherry-red	3.5	brittle
Tetrahedrite (Tennantite, Arsenfahlerz)	dk steel-gry	dark red-gray to cherry-red	3.5	brittle
Tetrahedrite (Hermesite, Quecksilberfahlerz)	steel-gray	black	3.5	brit to sect
Stannite (Zinnkies)	steel-gray to gray	black	3.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
H. capillary *S.* massive	*Clv.* in one dir *Fr.* thin stky, fib	$FeSb_2S_4$	G. 4.1. Melts in can fl. Often brightly tarnished. BB *ch.* gives off S and Sb fumes. Coats coal wh and leaves blk magn slag. Dissolves in HCl, giving off H_2S. *A.* Antimonite, Blende.
Orm *H.* acic prsm	*Clv.* 010 dist	$Bi_2(Se,S)_3$	G. 6.4.
Orm *H.* thick tab	*Clv.* bas perf	$Pb_3As_2S_5$	G. 5.5. BB *ch.* decrep, melts, yields fumes of As and but of argentif lead. *A.* Sartorite, Jordanite, Binnite.
Mcl *H.* thick tab, short clm *S.* massive	.....	$Ag\,SbS_2$	G. 5.3. Melts in can fl. BB *ch.* fus to gray bead, emitting S and Sb fumes. In O F leaves but of Ag. *A.* Pyrargyrite.
Hex *H.* rhdl	*Clv.* bas perf R and $-\frac{1}{2}$ R dist	As	G. 5.9. Fresh surf of frac tarnish in short time to gryh blk. Vol without melting. Xls very rare and small. Ignites in can fl. BB *ch.* odor of garlic. Coats with As oxide. Ctg vol in R F, tingeing flame blue. *A.* Proustite, Galenite, Chloanthite, Barite, Calcite.
Mcl or Trcl *H.* scaly	*Clv.* in one plane	CuO	G. 5.82. Soils fingers.
Ism *H.* tetr, dodl, $\frac{m.m}{2}$ *S.* masv, insp	....	$(Cu_2,Ag_2,Fe,Zn)_4Sb_2S_7$	G. 4.5–5.1. BB *ch.* fus, giving ctg of Sb oxide. Decomp by nitr ac, with sep of S and Sb ox. *A.* Chalcopyrite, Galenite, Bournonite, Blende, Siderite, Rhodocrosite, Barite.
Ism *H.* tetr, dodl *S.* masv, insp	.....	$(Cu_2,Fe,Zn)_4As_2S_7$	G. ± 4.7. BB, etc, as in preceding, with As ox for Sb ox. *A.* Chalcopyrite, Galenite, Blende.
Ism *H.* tetr	.....	$(Cu_2,Hg_2,Fe,Zn)_4$ $(Sb,As)_2S_7$	G. ± 4.7. Melts in can fl. BB faint dark gray subl at low red heat. Fus with soda in matrass drops of Hg condense on sides. *A.* Cinnabarite, Chalcopyrite, Siderite, Barite.
Ttrg *H.* hmhd *S.* massive	*Fr.* comp, fn-gr	Cu_2FeSnS_4	G. 4.4. Tarnishes brnz-yel. Gives no mal but. Sol in nitr ac, with sep of S and SnO_2. *A.* Chalcopyrite, Cassiterite, [illegible] senopyrite, Galenite.

Name	Color	Streak	Hardns	Tenacity
Berthierite	lead-gry to dark steel-gry	grayish-black	3	brittle
Frenzelite (Guanajuatite)	bluish-gray	gray, shining	3	sectile
Dufrenoysite	blackish lead-gray	reddish-brown	3	very brittle
Miargyrite (Silberantimonglanz)	steel-gry to iron-blk	dark cherry-red	3	sect to brit
Arsenic	lead-gry to tin-wh	grayish-black	3.5	brit to sect
Tenorite	stl-gry to earthy	stl-gry to blk	3.5	.....
Tetrahedrite (Antimonfahlerz. Comn var)	dk steel-gry lead-gry iron-blk	blk in part, inclining to cherry-red	3.5	brittle
Tetrahedrite (Tennantite, Arsenfahlerz)	dk steel-gry	dark red-gray to cherry-red	3.5	brittle
Tetrahedrite (Hermesite, Quecksilberfahlerz)	steel-gray	black	3.5	brit to sect
Stannite (Zinnkies)	steel-gray to gray	black	3.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
H. capillary *S.* massy	*Clv.* in one dir *Fr.* thin stky, fib	$FeSb_2S_4$	G. 4.1. Melts in can fl. Often brightly tarnished. BB *ch.* gives off S and Sb fumes. Coats coal wh and leaves blk magn slag. Dissolves in HCl, giving off H_2S. *A.* Antimonite, Blende.
Orm *H.* acic prsm	*Clv.* 010 dist	$Bi_2(Se,S)_3$	G. 6.4.
Orm *H.* thick tab	*Clv.* bas perf	$Pb_3As_2S_5$	G. 5.5. BB *ch.* decrep, melts, yields fumes of As and but of argentif lead. *A.* Sartorite, Jordanite, Binnite.
Mcl *H.* thick tab, short clm *S.* massy	.....	$AgSbS_2$	G. 5.3. Melts in can fl. BB *ch.* fus to gray bead, emitting S and Sb fumes. In O F leaves but of Ag. *A.* Pyrargyrite.
Hex *H.* rhdl	*Clv.* bas perf R and $-\frac{1}{2}$ R dist	As	G. 5.9. Fresh surf of frac tarnish in short time to gryh blk. Vol without melting. Xls very rare and small. Ignites in can fl. BB *ch.* odor of garlic. Coats with As oxide. Ctg vol in R F, tingeing flame blue. *A.* Proustite, Galenite, Chloanthite, Barite, Calcite.
Mcl or Trcl *H.* scaly	*Clv.* in one plane	CuO	G. 5.82. Soils fingers.
Ism *H.* tetr, dodl, $\frac{m.m}{2}$ *S.* masv, insp	....	$(Cu_2,Ag_2,Fe,Zn)_4Sb_2S_7$	G. 4.5–5.1. BB *ch.* fus, giving ctg of Sb oxide. Decomp by nitr ac, with sep of S and Sb ox. *A.* Chalcopyrite, Galenite, Bournonite, Blende, Siderite, Rhodocrosite, Barite.
Ism *H.* tetr, dodl *S.* masv, insp	.....	$(Cu_2,Fe,Zn)_4As_2S_7$	G. ± 4.7. BB, etc, as in preceding, with As ox for Sb ox. *A.* Chalcopyrite, Galenite, Blende.
Ism *H.* tetr	.....	$(Cu_2,Hg_2,Fe,Zn)_4(Sb,As)_2S_7$	G. ± 4.7. Melts in can fl. BB faint dark gray subl at low red heat. Fus with soda in matrass drops of Hg condense on sides. *A.* Cinnabarite, Chalcopyrite, Siderite, Barite.
Ttrg *H.* hmhd *S.* massy	*Fr.* comp, fn-gr	Cu_2FeSnS_4	G. 4.4. Tarnishes brnz-yel. Gives no mal but. Sol in nitr ac, with sep of S and SnO_2. *A.* Chalcopyrite, Cassiterite, Arsenopyrite, Galenite, Blende.

Name	Color	Streak	Hardns	Tenacity
Nagyagite (Blättertellurerz) (See I 4)	iron-black	grayish-black	1.5	sect to mal
Pyrolusite (Weichmanganerz)	lt iron-blk to dk steel-gry	black	2	sect to brit
Aguilarite	iron-black	.....	2.5	sect
Acanthite	iron-black	gray-black	2.5	malleable
Chalcophanite (See II 1)	bluh-blk, bril	choc-brn	2.5	flexible
Polybasite (Eugenglanz, Sprödglaserz in part)	iron-black	black	2.5	sect to brit
Stromeyerite (Silberkupferglanz)	iron-black	black, lustrous	2.75	sect to mal
Stephanite (Melanglanz, Sprödglaserz in part)	iron-black to black lead-gray	gray-black	2.75	mild
Chalcocite (Kupferglanz) (See I 4)	blk lead-gry to iron-blk	black	2.75	sect to mal
Bournonite (See I 4)	iron-blk to steel-gry	gray-black	2.75	brittle to mild
Metacinnabarite	grayish-black	black	.....	.....
Enargite	iron-black	black	3	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ttrg	*Clv.* bas. perf.	$Au_2Pb_{14}Sb_3(Te,S)_{24}$	G. 6.9.
Orm *H.* clm, acic, cap *S.* massive	*Fr.* stky, fibr, gran	MnO_2 (with 1 or 2 p c H_2O)	G. 4.8. Infus. Soils white paper. BB *ch.* loses O. Gives Cl with HCl. *A.* Psilomelane, Barite.
Ism	*Fr.* hackly	Ag_4SeS_2	G. 7.586.
Orm *H.* dart-like, in blades	.....	Ag_2S	G. 7.2. BB yields SO_2, and gives Ag but with soda. *A.* Argentite.
Hex *H.* rhdl	*Clv.* bas perf	Mn,Zn,Fe,H,O	G. 3.9. BB brns to cop-rd
Orm *H.* scaly, tab *S.* insp	*Clv.* bas dist	$(Ag,Cu)_{16}(Sb,As)_2S_{12}$	G. 6.2. Trsl in thin slabs. Melts in can fl. BB *ch.* fus, with spirting, to but, giving S and Sb fumes. *A.* Stephanite, Argentite, Siderite, Fluorite, Barite.
Orm	*Fr.* sub-cnch	$(Cu,Ag)_2S$	G. 6.2. Closed tube, fus; gives no subl. Open tube, S fumes. BB *ch.* O F fus to semi-mal but. Sol in nitr ac.
Orm *H.* thick tab, short and long clm *S.* masv, insp	.....	$Ag_{10}Sb_2S_3$	G. 6.2. Xls seem hex. Melts in can fl. BB *ch.* fus, throwing off small particles. Coats coal with Sb ox. After time red, from oxidized Ag. Sol in hot nitr ac, depositing S and Sb. *A.* Argentite, Pyrargyrite, Silver, Barite.
Orm	*Clv.* basal	Cu_2S	G. ± 5.6.
Orm *H.* short clm, tab, cuboid, obtuse pyrl	.....	$Pb_2Cu_2(SbS_3)_2$	G. 5.8.
Ism *H.* tetr	*Fr.* subc to unvn	HgS	G. 7.8.
Orm *H.* short clm, short ac *S.* massive	*Clv.* 110 perf, 100 } 010 } dist	Cu_3AsS_4	G. 4.4. BB in closed tube decrep and gives subl of S; at higher temp, subl of arsenous sulphides. Fus on *ch.* and gives but of Cu. *A.* Tennantite, Chalcopyrite.

Name	Color	Streak	Hardns	Tenacity
Coloradoite				
Miargyrite (See I 4)	iron-blk to steel-gry	dark cherry-red	3	sectile
Famatinite	gray cop-red	black	3.5	rather brit
Tetrahedrite (Antimonfahlerz) (See I 4)	iron-black	brown-black	3.5	brittle
Alabandite (Manganblende)	iron-black	dark green	3.75	brit to sect
Manganite	iron-black	reddish-brown	4.25	sect to brit
Melaconite (Tenorite)	iron-black	black	5	brit to sect
Hausmannite	iron-black	brn smts rdsh-brn	5.5	brittle
Magnetite (Magneteisenerz)	iron-black	blackish-gray	5.5	brittle
Fergusonite (See II 2)	brnh-black	pl brn	5.75	brittle
Jacobsite	deep black	blkh-brn	6.–	brittle
Menaccanite (Ilmenite, Titaneisenerz)	iron-black	blk, rdsh-brn	6	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl	.....	$AgSbS_2$	G. 5.3. (See I. 4.)
Orm	*Fr.* uneven	Cu_2SbS_4	G. 4.57.
Ism	.....	.....	G. 4.5 to 5.1. (See I. 4.)
Ism *H.* octl	*Clv.* cub dist	MnS	G. 4. Often tarnishes dk brn. BB infus. *A.* Blende, Rhodocrosite.
Orm *H.* ac, clm *S.* massive	*Clv.* 010 very perf, 110 perf *Fr.* thin stky, fib	MnO.OH	G. 4.3. BB infus. Yields water. Borax and mcrc, amethystine bead; cls in R F. Gives Cl with HCl. *A.* Barite Calcite.
Mcl (?)	.....	CuO	G. 6. Usually in scales. Soils fingers. BB O F infus. Colors flame grn. Moistened with HCl, as blue. Sol in concentrated HCl. *A.* Found in lava on Vesuvius and in some copper mines.
Ttrg *H.* acute pyr *S.* massive	*Clv.* bas. dist *Fr.* granular	Mn_2MnO_4	G. 4.7. BB infus. (See MANGANITE, above.) *A.* Pyrolusite, Psilomelane, Braunite, Barite.
Ism *H.* octl, dodl *S.* masv, insp	*Fr.* comp, gran	$Fe(FeO_2)_2$	G. ± 5. Strongly magn. BB fus with great difficulty. In O F loses magn. Sol in HCl. *A.* In eruptive and metamorphic rocks.
Ism *H.* dsto octns	.....	$MgMn_3Fe_2O_4$	G. 4.75. Jakobsburg, Sweden.
Ttrg *H.* hmhdl	*Clv.* pyrl	$(Y,Er,Ce)(NbTa)O_4$	G. 5.8.
Hex *H.* rhdl, tab *S.* masv, interspersed	*Clv.* R, rarely *Fr.* granular	$(Fe,Ti)_2O_3$	G. 4.7. BB infus. Partly magn. O F slightly rnd on edges. With mcrc reac for iron. In R F, treated with tin, violet color. Powdered and heated with HCl, slowly dissolved to yel sol. *A.* Rutile, Titanite, Apatite, Feldspar.

Name	Color	Streak	Hardns	Tenacity
Chromite (Chromeisenerz)	iron-black	dk to lt brn	6	brittle
Columbite (Niobite)	iron-black	brownish-black	6	brittle
Franklinite	iron-black	reddish-brown	6.25	brittle
Rutile (See II 2)	iron-black	yellowish-brown	6.5	brittle
Hematite (Specularite)	iron-blk to steel-gry	cherry-, brn-, blk-red	6.5	brittle
Braunite (Marcellin) (See II 1)	iron-black	brownish-black	6.25	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* octl *S.* masv, insp	*Fr.* gran, comp	$(Fe,Cr)[(Cr,Fe)O_2]_2$	G. 4.3. Xls small and rare. Usually slightly magn. BB infus. With borax and mcrc, iron reac hot and chrome-grn cold. *A.* In Serpentine.
Orm	*Clv.* 010 dist	$[(Nb,Ta)O_3]_2Fe$	G. 6. BB infus. Like Tantalite. Decomp by fusion with potash, and treated with HCl and H_2SO_4 gives on addition of Zn a blue color. *A.* Beryl in Granite.
Ism *H.* octl *S.* massive	*Fr.* compact	$(Fe,Mn,Zn)(FeO_2)_2$	G. 5. BB infus. Slightly magn. With borax in O F rdsh-amethyst bead (Mn), and in R F bottle-grn (Fe). *A.* Zincite, Willemite.
Ttrg	*Clv.* 100 & 110	$TiTiO_4$	G. 4.
Hex *H.* rhdl, tab, pyrl	*Clv.* R seld dist	Fe_2O_3	G. 4.8. BB infus. Smts magn and magneto-polar.
Ttrg	*Clv.* 110	$MnMnO_3$	.....

[illegible]	[illegible]	[illegible]	[illegible]	Tenacity
[illegible]	[illegible]	[illegible]	6	brittle
[illegible]	[illegible]	[illegible]	6	brittle
[illegible]	[illegible]	[illegible]	6.25	brittle
[illegible]	[illegible]	[illegible]	6.5	brittle
[illegible]	[illegible]	[illegible]	6.5	brittle
[illegible]	[illegible]	brownish-black	6.25	brittle

Crystal System Habit and Structure	Cleavage and Fracture	[illegible]
Ism *H*. octl *S*. masv. insp	[illegible]	[illegible]
Orm	[illegible]	[illegible]
Ism *H*. octl *S*. massive	[illegible]	[illegible]
Ttrg	[illegible]	[illegible]
Hex *H*. rhdl, tab, pyrl	[illegible]	[illegible]
Ttrg	[illegible]	[illegible]

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II MINERALS OF SUB-METALLIC

OF BLACK, BROWN, RED, YELLOW,

1 Of Black Streak

Name	Lustre	Color	Streak	Hardns	Tenacity
Asbolite (Erdkobalt)	slightly res	bluish-black	bluish-black	1.25	sectile to malleable
Asphaltum (Erdpech)	resinous	pitch-black	blk to brn	1.25	sectile
Covellite (Kupferindig)	sub-met to adm	dk blue indigo-blue steel-blue	blue-black	1.5-2	sectile to brittle
Chalcophanite	brilliant	bluh-blk	choc-brn	2.5	flexible
Bituminous Coal	res to vitr or silky	black partly brown	black	2.5	sectile to brittle
Anthracite	sub-met vitr	black	black	2.75	very brittle
Enargite (See I 5)	sub-metallic	iron-black	black	3	brittle
Sphalerite (Blende, Zink-blende)	vitreous	black	brnh-blk	4	brittle

AND NON-METALLIC LUSTRE

GREEN, OR BLUE STREAK

(all Opaque)

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Amorphous *S.* bot, masv, powdery, ctg	.....	$Co(Fe,Cu)O+xH_2O$	G. ± 3.5. Unct. Var of Wad. BB infus. Blue bead with mcrc. *A.* Malachite, Barite, Tetrahedrite.
Amorphous *S.* masv, incr	*Fr.* conchoidal	$C_{14}H_{18}O$	G. ± 1.5. Sticky. Ignitible by can fl, and burning with light. *A.* In limestone, marl, clay, sandstone.
Hex *H.* rhdl, thin tab *S.* masv, lam, ctg, powd	*Clv.* bas & prsm, obs *Fr.* comp, fn & small-gr, stky	CuS	G. 4. Xls very rare. Ignitible in can fl, and burning with blue flame. (BB see CHALCOCITE, I 4.) *A.* Chalcopyrite, Pyrite.
Hex *H.* rhdl	*Clv.* bas perf	Mn,Zn,Fe,H,O	G. 3.9. BB brnz to cop rd.
Amorphous *S.* massive	*Fr.* cnch to plane, comp, slaty, fib	C, H, O with ash	G. 1.4–1.6. Ignitible by a can, and burning with light. *A.* Pyrite.
Amorphous *S.* massive	*Fr.* cnch, comp	C with little H, O, etc, and ash	G. ± 1.7. Not ignitible by can fl. Hard to ignite and burning with little or no flame. *A.* Slate, Pyrite.
Orm	*Clv.* 110 perf	Cu_3AsS_4	G. 4.4.
Ism *H.* octl, cub, tetr, dodl *S.* masv, insp, rnfm, sphl	*Clv.* 110 hly perf *Fr.* gran, comp, scy, fib	$(Zn,Fe,_{Mn,Cd})S$	G. 4. BB fus with great difficulty. *Ch.* some vars rdsh-brn ctg of Cd oxide take a wh coat of zinc ox, yel hot, and wh when cold. *A.* Arsenopyrite, Magnetite, Chalcopyrite, Magnetopyrite, Galenite, Garnet, Pyroxene.

Name	Lustre	Color	Streak	Hardns	Tenacity
Uraninite (Uranpecherz)	resinous partly metallic	black	gryh-blk to brnh-blk	5.5	brittle
Dysanalyte	sub-met	iron-blk	.....	5.5	.....
Ilvaite (Lievrite)	resinous to semi-met	black	grnh-blk	5.75	brittle
Columbite (Niobit)	vitr adm metalloid	black	gryh to brnh-blk	6	brittle
Psilomelane (Hartmanganerz)	sub- to non-met: streak more lustrous	bluish-black	blk, in part brn	6.25	brittle
Braunite (Marcellin)	sub-metallic	black	black	6.25	brittle
Schorlomite	vitreous	blk, trnsh blu	gryh-blk	7.25	.....

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Bog Manganese (Manganschaum, Groroilith, Wad)	glistening	black-brown to blue-black	black-brown	1	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* octl *S.* masv, insp, rnfm	*Fr.* comp, cnch to unvn	$(U,Pb_2)_3(UO_6)_2$(?)	G. 6.4.–8. Xls rare. Radio-active. BB fus with great difficulty, coloring outer fl grn. With borax and mcrc, yel bead in O F becoming grn in R F (Uranium). *A.* Torbernite, Galenite, Chalcopyrite, Chloanthite, Bismuth, Pyrargyrite, Barite, Fluorite, in granite.
Ism	*Clv.* cub	$Na_2(Ca,Fe)_3Ce(Nb\text{-}O_3)_3Ti_{10}O_{20}$	G. 4.13. In gran limestone.
Orm *H.* clm, ac *S.* masv	*Clv.* 010 dist *Fr.* stalky	$Fe_2Ca(Fe.OH)(SiO_4)_2$	G. ± 4. BB infus. Gelatinizes with HCl. *A.* Amphibole, Pyroxene.
Orm *H.* short clm, short ac, tab *S.* insp	*Clv.* 010 dist	$Fe(NbO_3)_2$ or $Fe[(Nb,Ta)O_3]_2$	G. ± 6. BB infus. (See I 5.) *A.* Beryl, in granite.
Amorphous *S.* reniform, bot, masv	*Fr.* cnch to unvn	Principally Manganate of Manganese. Much of latter replaced by Ba. Some Ca, Mg, Cu, Al, Fe, and alkalies with H_2O.	G. ± 4. Surf of nod gen smooth. BB infus; loses O. Yields Cl with HCl. *A.* Pyrolusite, Polianite, Limonite, Barite.
Ttrg *H.* pyramidal *S.* massive	*Fr.* unvn, gran, comp	$MnMnO_3$. Contains also some Manganese Silicate	G. ± 4.7. Xls small. Evolves Cl with HCl. BB infus. With borax and mcrc, amethyst bead in O F becoming cls in R F. *A.* Pyrolusite, Psilomelane, Hausmannite, Barite.
Ism *H.* trpz, dodl	*Fr.* cnch	$(Ca,Fe,Mg)_3(Fe,Ti)_2[(Si,Ti)O_4]_3$	G. 3.85.

Of Brown Streak

Amorphous *S.* reniform, bot, masv	*Fr.* unvn, ethy	Mostly MnO_2 with Mn-O and 5 to 14 p c of H_2O. Contains limonite, calcite, and other subst'ncs	G. ± 3.7. Opaque. Greasy to touch. BB infus. (See PSILOMELANE, II 1.) *A.* Psilomelane, Pyrolusite, Limonite, Siderite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Ozocerite (Erdwachs)	resinous	brown	yellow-brown	1	ductile
Chloropal (Fettbol, Gramenit, Pinguit, Nontronit)	resinous	liver-brown	liver-brown	1.75	sectile
Asphaltum (Erdpech) (See II 1)	resinous	blk to brn	brnh-blk	2	sect to brit
Plattnerite (Schwerbleierz)	met adm	iron-black	brown	.....	brittle
Lignite (Braunkohle)	resinous	brn to blk	brown, partly black	2.5	sect to brit
Chrysocolla (Kieselkupfer)	vitr, res, ethy	grn (brn or blk when impure)	greenish-brown	3.5	brittle
Siderite (Eisenspath)	vitr to prly	pale yel, yel-brn	yellowish-brown	4	brittle
Sphalerite (Blende) (See II 1)	vitr to adm	blk to brn	blk-, pink-, lt brown	4	brittle
Xenotime (Ytterspath)	res to vitr	yelh, rdsh, brn	yelh, rdsh, brn	4.5	brittle
Göthite (Lepidocrocite)	adm, velvety, silky	brown	yelh-brown	4.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Amorphous *S.* massive	*Fr.* comp, fib	Hydrocarbon of Methane series of high boiling-point.	G. 0.95. Aromatic odor. Sticky. Inflam with bright fl. *A.* Bituminous coal, bituminous clay slate.
Amorphous *S.* msv, ethy	*Fr.* cnch, ethy	$(Fe,Al)_2(SiO_3)_3.5H_2O$	G. 1.7. Opaque. Greasy feel. BB yields water. Infus, but blkens and becomes magn. Partially decomp by HCl. *A.* Barite, Fluorite.
Amorphous	*Fr.* conchoidal	$C_{14}H_{18}O$	G. 1.5.
Hex *H.* clm *S.* ctg, pseudomorphs	*Fr.* uneven	PbO_2	G. 9.4.
Amorphous *S.* massive	*Fr.* ethy, comp, fib	More or less carbonized vegetable matter containing C, H, O, N, S, and ash	G. ± 1.4. Opaque. Inflam in the can fl, and burning with light. *A.* Pyrite, Marcasite, Sulphur, Gypsum.
Amorphous *S.* masv, insp, reniform	*Fr.* cnch, comp, ethy	$CuSiO_3.2H_2O$, often with some Al silicate	G. 2.1. Opaque. Closed tube, blkens and gives water. BB decrep, and colors fl grn. Infus. Frequent in cap rock. *A.* Malachite, Chalcopyrite, Chalcocite, Cuprite.
Hex *H.* rhdl, obt and acu R, sclh *S.* masv, rnfm, wrty, nod, lam	*Clv.* R 107° perf, partly curved faces *Fr.* gran, shly, comp	$FeCO_3$. Contains often Mg, Mn, and Ca.	G. 3.8. Brn by weathering. In closed tube decrep and becomes magn. BB infus. Blkens. By exposure it dkens. Effervesces in weak acid. *A.* Galenite, Blende, Chalcopyrite, Tetrahedrite, Linnæite, Cinnabar, Barite, Fluorite.
Ism	*Clv.* 110 perf	ZnS (impurities Fe and Cd)	G. 4. BB fus. with difficulty. *A.* Arsenopyrite, Chalcopyrite, Magnetopyrite, Pyrite, Galenite, Siderite, Barite, Garnet, Pyroxene, Magnetite.
Ttrg *H.* pyrm	*Clv.* 110 perf *Fr.* unvn spln	$(Y,Ce)PO_4$	G. 4.45.
Orm *H.* ac, scaly *S.* masv, rnfm	*Clv.* 010 nearly perf *Fr.* thin stky, scaly	FeO.OH	G. 4. Opaque. Gives off water and is converted to sesquioxide in closed tube. Surf of mass bot. BB infus. Reac for iron. *A.* Limonite, Hematite, Specularite.

Name	Color	Streak	Hardns	Tenacity
Chromite (Chromeisenerz)	iron-black	dk to lt brn	6	brittle
Columbite (Niobite)	iron-black	brownish-black	6	brittle
Franklinite	iron-black	reddish-brown	6.25	brittle
Rutile (See II 2)	iron-black	yellowish-brown	6.5	brittle
Hematite (Specularite)	iron-blk to steel-gry	cherry-, brn-, blk-red	6.5	brittle
Braunite (Marcellin) (See II 1)	iron-black	brownish-black	6.25	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* octl *S.* masv, insp	*Fr.* gran, comp	$(Fe,Cr)[(Cr,Fe)O_2]_2$	G. 4.3. Xls small and rare. Usually slightly magn. BB infus. With borax and mcrc, iron reac hot and chrome-grn cold. *A.* In Serpentine.
Orm	*Clv.* 010 dist	$[(Nb,Ta)O_3]_2Fe$	G. 6. BB infus. Like Tantalite. Decomp by fusion with potash, and treated with HCl and H_2SO_4 gives on addition of Zn a blue color. *A.* Beryl in Granite.
Ism *H.* octl *S.* massive	*Fr.* compact	$(Fe,Mn,Zn)(FeO_2)_2$	G. 5. BB infus. Slightly magn. With borax in O F rdsh-amethyst bead (Mn), and in R F bottle-grn (Fe). *A.* Zincite, Willemite.
Ttrg	*Clv.* 100 & 110	$TiTiO_4$	G. 4.
Hex *H.* rhdl, tab, pyrl	*Clv.* R seld dist	Fe_2O_3	G. 4.8. BB infus. Smts magn and magneto-polar.
Ttrg	*Clv.* 110	$MnMnO_3$	.....

II MINERALS OF SUB-METALLIC

OF BLACK, BROWN, RED, YELLOW,

1 Of Black Streak

Name	Lustre	Color	Streak	Hardns	Tenacity
Asbolite (Erdkobalt)	slightly res	bluish-black	bluish-black	1.25	sectile to malleable
Asphaltum (Erdpech)	resinous	pitch-black	blk to brn	1.25	sectile
Covellite (Kupferindig)	sub-met to adm	dk blue indigo-blue steel-blue	blue-black	1.5-2	sectile to brittle
Chalcophanite	brilliant	bluh-blk	choc-brn	2.5	flexible
Bituminous Coal	res to vitr or silky	black partly brown	black	2.5	sectile to brittle
Anthracite	sub-met vitr	black	black	2.75	very brittle
Enargite (See I 5)	sub-metallic	iron-black	black	3	brittle
Sphalerite (Blende, Zink-blende)	vitreous	black	brnh-blk	4	brittle

AND NON-METALLIC LUSTRE

GREEN, OR BLUE STREAK

(all Opaque)

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Amorphous *S.* bot, masv, powdery, ctg	.....	$Co(Fe,Cu)O + xH_2O$	G. ± 3.5. Unct. Var of Wad. BB infus. Blue bead with mcrc. *A.* Malachite, Barite, Tetrahedrite.
Amorphous *S.* masv, incr	*Fr.* conchoidal	$C_{14}H_{18}O$	G. ± 1.5. Sticky. Ignitible by can fl, and burning with light. *A.* In limestone, marl, clay, sandstone.
Hex *H.* rhdl, thin tab *S.* masv, lam, ctg, powd	*Clv.* bas & prsm, obs *Fr.* comp, fn & small-gr, stky	CuS	G. 4. Xls very rare. Ignitible in can fl, and burning with blue flame. (BB see CHALCOCITE, I 4.) *A.* Chalcopyrite, Pyrite.
Hex *H.* rhdl	*Clv.* bas perf	Mn,Zn,Fe,H,O	G. 3.9. BB brns to cop rd.
Amorphous *S.* massive	*Fr.* cnch to plane, comp, slaty, fib	C, H, O with ash	G. 1.4–1.6. Ignitible by a can, and burning with light. *A.* Pyrite.
Amorphous *S.* massive	*Fr.* cnch, comp	C with little H, O, etc, and ash	G. ± 1.7. Not ignitible by can fl. Hard to ignite and burning with little or no flame. *A.* Slate, Pyrite.
Orm	*Clv.* 110 perf	Cu_3AsS_4	G. 4.4.
Ism *H.* octl, cub, tetr, dodl *S.* masv, insp, rnfm, sphl	*Clv.* 110 hly perf *Fr.* gran, comp, scy, fib	$(Zn,Fe,Mn,Cd)S$	G. 4. BB fus with great difficulty. *Ch.* some vars rdsh-brn ctg of Cd oxide take a wh coat of zinc ox, yel hot, and wh when cold. *A.* Arsenopyrite, Magnetite, Chalcopyrite, Magnetopyrite, Galenite, Garnet, Pyroxene.

Name	Lustre	Color	Streak	Hardns	Tenacity
Uraninite (Uranpecherz)	resinous partly metallic	black	gryh-blk to brnh-blk	5.5	brittle
Dysanalyte	sub-met	iron-blk	.....	5.5	.....
Ilvaite (Lievrite)	resinous to semi-met	black	grnh-blk	5.75	brittle
Columbite (Niobit)	vitr adm metalloid	black	gryh to brnh-blk	6	brittle
Psilomelane (Hartmanganerz)	sub- to non-met: streak more lustrous	bluish-black	blk, in part brn	6.25	brittle
Braunite (Marcellin)	sub-metallic	black	black	6.25	brittle
Schorlomite	vitreous	blk, trnsh blu	gryh-blk	7.25	.....

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Bog Manganese (Manganschaum, Groroilith, Wad)	glistening	black-brown to blue-black	black-brown	1	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* octl *S.* masv, insp, rnfm	*Fr.* comp, cnch to unvn	$(U,Pb_2)_3(UO_6)_3(?)$	G. 6.4.–8. Xls rare. Radio-active. BB fus with great difficulty, coloring outer fl grn. With borax and mcrc, yel bead in O F becoming grn in R F (Uranium). *A.* Torbernite, Galenite, Chalcopyrite, Chloanthite, Bismuth, Pyrargyrite, Barite, Fluorite, in granite.
Ism	*Clv.* cub	$Na_2(Ca,Fe)_5Ce(Nb-O_3)_3Ti_{10}O_{29}$	G. 4.13. In gran limestone.
Orm *H.* clm, ac *S.* masv	*Clv.* 010 dist *Fr.* stalky	$Fe_2Ca(Fe.OH)(SiO_4)_2$	G. ± 4. BB infus. Gelatinizes with HCl. *A.* Amphibole, Pyroxene.
Orm *H.* short clm, short ac, tab *S.* insp	*Clv.* 010 dist	$Fe(NbO_3)_2$ or $Fe[(Nb,Ta)O_3]_2$	G. ± 6. BB infus. (See I 5.) *A.* Beryl, in granite.
Amorphous *S.* reniform, bot, masv	*Fr.* cnch to unvn	Principally Manganate of Manganese. Much of latter replaced by Ba. Some Ca, Mg, Cu, Al, Fe, and alkalies with H_2O.	G. ± 4. Surf of nod gen smooth. BB infus; loses O. Yields Cl with HCl. *A.* Pyrolusite, Polianite, Limonite, Barite.
Ttrg *H.* pyramidal *S.* massive	*Fr.* unvn, gran, comp	$MnMnO_3$. Contains also some Manganese Silicate	G. ± 4.7. Xls small. Evolves Cl with HCl. BB infus. With borax and mcrc, amethyst bead in O F becoming cls in R F. *A.* Pyrolusite, Psilomelane, Hausmannite, Barite.
Ism *H.* trpz, dodl	*Fr.* cnch	$(Ca,Fe,Mg)_3(Fe,Ti)_2[(Si,Ti)O_4]_3$	G. 3.85.

Of Brown Streak

Amorphous *S.* reniform, bot, masv	*Fr.* unvn, ethy	Mostly MnO_2 with Mn-O and 5 to 14 p c of H_2O. Contains limonite, calcite, and other subst'ncs	G. ± 3.7. Opaque. Greasy to touch. BB infus. (See PSILOMELANE, II 1.) *A.* Psilomelane, Pyrolusite, Limonite, Siderite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Ozocerite (Erdwachs)	resinous	brown	yellow-brown	1	ductile
Chloropal (Fettbol, Gramenit, Pinguit, Nontronit)	resinous	liver-brown	liver-brown	1.75	sectile
Asphaltum (Erdpech) (See II 1)	resinous	blk to brn	brnh-blk	2	sect to brit
Plattnerite (Schwerbleierz)	met adm	iron-black	brown	.....	brittle
Lignite (Braunkohle)	resinous	brn to blk	brown, partly black	2.5	sect to brit
Chrysocolla (Kieselkupfer)	vitr, res, ethy	grn (brn or blk when impure)	greenish-brown	3.5	brittle
Siderite (Eisenspath)	vitr to prly	pale yel, yel-brn	yellowish-brown	4	brittle
Sphalerite (Blende) (See II 1)	vitr to adm	blk to brn	blk-, pink-, lt brown	4	brittle
Xenotime (Ytterspath)	res to vitr	yelh, rdsh, brn	yelh, rdsh, brn	4.5	brittle
Göthite (Lepidocrocite)	adm, velvety, silky	brown	yelh-brown	4.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Amorphous *S.* massive	*Fr.* comp, fib	Hydrocarbon of Methane series of high boiling-point.	G. 0.95. Aromatic odor. Sticky. Inflam with bright fl. *A.* Bituminous coal, bituminous clay slate.
Amorphous *S.* msv, ethy	*Fr.* cnch, ethy	$(Fe,Al)_2(SiO_3)_3.5H_2O$	G. 1.7. Opaque. Greasy feel. BB yields water. Infus, but blkens and becomes magn. Partially decomp by HCl. *A.* Barite, Fluorite.
Amorphous	*Fr.* conchoidal	$C_{14}H_{18}O$	G. 1.5.
Hex *H.* clm *S.* ctg, pseudomorphs	*Fr.* uneven	PbO_2	G. 9.4.
Amorphous *S.* massive	*Fr.* ethy, comp, fib	More or less carbonized vegetable matter containing C, H, O, N, S, and ash	G. ± 1.4. Opaque. Inflam in the can fl, and burning with light. *A.* Pyrite, Marcasite, Sulphur, Gypsum.
Amorphous *S.* masv, insp, reniform	*Fr.* cnch, comp, ethy	$CuSiO_3.2H_2O$, often with some Al silicate	G. 2.1. Opaque. Closed tube, blkens and gives water. BB decrep, and colors fl grn. Infus. Frequent in cap rock. *A.* Malachite, Chalcopyrite, Chalcocite, Cuprite.
Hex *H.* rhdl, obt and acu R, sclh *S.* masv, rnfm, wrty, nod, lam	*Clv.* R 107° perf, partly curved faces *Fr.* gran, shly, comp	$FeCO_3$. Contains often Mg, Mn, and Ca.	G. 3.8. Brn by weathering. In closed tube decrep and becomes magn. BB infus. Blkens. By exposure it dkens. Effervesces in weak acid. *A.* Galenite, Blende, Chalcopyrite, Tetrahedrite, Linnæite, Cinnabar, Barite, Fluorite.
Ism	*Clv.* 110 perf	ZnS (impurities Fe and Cd)	G. 4. BB fus. with difficulty. *A.* Arsenopyrite, Chalcopyrite, Magnetopyrite, Pyrite, Galenite, Siderite, Barite, Garnet, Pyroxene, Magnetite.
Ttrg *H.* pyrm	*Clv.* 110 perf *Fr.* unvn spln	$(Y,Ce)PO_4$	G. 4.45.
Orm *H.* ac, scaly *S.* masv, rnfm	*Clv.* 010 nearly perf *Fr.* thin stky, scaly	FeO.OH	G. 4. Opaque. Gives off water and is converted to sesquioxide in closed tube. Surf of mass bot. BB infus. Reac for iron. *A.* Limonite, Hematite, Specularite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Wolframite (Hübnerite)	sub-met and adm	black	red-, blk-brown	5	brittle
Polycrase	vitr to res	blk, brn in splint	gryh-brown	5.5	brittle
Samarskite (Yttroilmenite)	vitr to res	velvet-black	dark rdsh-brn	5.5	brittle
Limonite (Brauneisenerz)	non-metallic	brown	yellow-brown	5.5	brittle
Aeschynite	sub-met dull	brn to blk	gry to blk	5.5	brittle
Fergusonite (Tyrite) I 5	vitr dull	brnh-blk	pale brn	5.75	brittle
Braunite (Marcellin) (See II 1)	sub-metallic	black	dark brown	6.25	brittle
Psilomelane (Hartmanganerz) (See II 1)	non- to sub-met	black	dark brown	6.25	brittle
Euxenite	met vitr unct	brn-blk	yel, rd, brn	6.5	brittle
Polymignite	sub-met, bril	black	dark brn	6.5	brittle
Rutile	metalloid adamantine	black-brown	light brown, partly yellow	6.5	brittle
Cassiterite (Zinnerz)	metalloid res	black-brown	light brown	6.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl *H.* short clm, thick tab, spln, ac *S.* masv, insp	*Clv.* 010 perf *Fr.* thin stky	$(Fe,Mn)WO_4$	G. ± 7.2. BB fus easily to magn but, which has a xln surface. With mcrc, rdsh-yel glass while hot. On *ch.* with tin on cooling grn, which becomes rdsh-yel in continued R F. *A* Arsenopyrite, Molybdenite, Cassiterite, Bismuth, Fluorite, Apatite.
Orm *H.* prsm tab	*Fr.* cnch	$(Ca,Fe)_2Y_4UO_2Ti_{12}O_{35}[Y(NbO_3)_3]_3$	G. 5.
Orm *H.* prsm	*Clv.* 010 imp *Fr.* cnch	$[(Fe,Y,Ce,Er)_4(Nb_2O_7)_3]_3(Fe,Y,Ce,Er)U_5O_{21}$	G. 5.7.
Crystalline *S.* rnfm, globular, masv, insp, powdery	*Fr.* fib, stky, ethy, shly, comp	$Fe_4O_3(OH)_6$	G. 4. Often tarnished blk. (BB, *A.*, etc, see GÖTHITE, II 2.)
Orm	*Fr.* small cnch		
Ttrg *H.* Pyrm	*Fr.* sbcn	$Y(Nb,Ta)O_4$	G. 5.838
Ttrg	*Fr.* uneven	$MnMnO_3$	G. 4.7. BB Mn reac with the fluxes. *A.* Pyrolusite, Psilomelane, Hausmannite, Barite.
Amorphous	*Fr.* cnch	Manganese Manganate	G. 4.
Orm	*Fr.* sbcn	Ce,Er,Yt,Ti,Cb,O	G. 4.6.
Orm	*Fr.* cnch, perf	K,Na,Ca,H,Pb,Fe, La,Di,Ce,Y,Er,Sn, Th,Ti,Zr,Ta,Cb	G. ± 4.81.
Ttrg *H.* clm, ac *S.* masv, insp	*Clv.* 100 perf, 110 dist *Fr.* comp	$TiTiO_4$	G. 4. Opaque. BB infus. With mcrc a clss bead, which, in R F, becomes violet on cooling. *A.* Menaccanite (Titanic iron ore), Titanite, Apatite.
Ttrg *H.* clm, acic, pyrl *S.* masv, insp, rnd	*Clv.* 100 perf, 110 dist	$SnSnO_4$	G. 6.8. Opaque. BB infus. On *ch.* with soda, but of met Sn and wh coat. *A.* Arsenopyrite, Wolframite, Scheelite, Molybdenite, Bismuth, Blende, Fluorite Apatite, Lepidolite.

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Name	Lustre	Color	Streak	Hardns	Tenacity
Selensulphur	earthy	orange-red	.....	.....	pulv
Remingtonite	earthy	rose-red	pale rose	.....	.....
Kermesite (Rothspiessglas-erz, Antimon-blende, Pyrostibite)	adm satiny	dk bluh to cherry-red	dark bluish-red	1	sectile
Cinnabar (Zinnober)	adamantine	cochineal-red	scarlet	2.25	sectile
Pyrostilpnite (Feuerblende, Pyrochrotit)	adm, on 010 pearly	yelh to hya-cinth-red	auroral red	2.5	sect to brit
Erythrite (Kobaltblüthe)	vitr 010 m. o. p.	crimson- & peach-red, smts pearl- or grn-gray	paler than mineral, dry powder deep laven-der-blue	2.5	sect to brit
Proustite (Lichtes Roth-gültigerz)	adamantine	cochineal-red auroral red	auroral to scarlet	2.75	sect to brit
Pyrargyrite (Dunkles Rothgültigerz)	met adm	blk, smts approach-ing cochi-neal-red	cochineal-, cherry-, purple-red	3	sectile to brittle
Chrysocolla (Kieselkupfer) (See II 2)	res or vitr to ethy	brn to brnh-blk; when pure, moun-tain-grn to sky-blue	brnh-red; when pure, wh	3.5	brittle

Of Red Streak

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
.....	.....	SeS	G.
.....	.....	Co, H, C, O	G.
Mcl *H.* capillary *S.* tufted	*Clv.* 100 dist *Fr.* fib, stel	Sb_2S_2O	G. 4.5. Melts in can fl. Thin leaves, fix. Closed tube, blkens, and gives first wh and then dk-red subl. *A.* Antimonite, Berthierite, Cervantite (Antimonoker), Valentinite.
Hex *H.* rhdl, thick tab, short clm, short ac *S.* masv, insp, ctg	*Clv.* prsm, very perf *Fr.* gran, comp, fib, ethy	HgS	G. 9. Subl in matrass. Open tube, S fumes and met Hg in drops on cold wall of tube. BB vol. *A.* Hermesite, Mercury, Chalcopyrite, Siderite Barite.
Mcl *H.* splintery	*Clv.* 010 perfect	Ag_3SbS_3	G. 4.25. Melts in can fl. BB, like Pyrargyrite (see below). *A.* Pyrargyrite.
Mcl *H.* spln, ac *S.* wrty, ctg	*Clv.* 010 hly perf *Fr.* fib, thin stky, ethy	$Co_3(AsO_4)_2.8H_2O$	G. ± 3. BB *ch.* As odor; with borax, cobalt glass. *A.* Smaltite.
Hex *H.* rhdl, dart-like, ac, clm, thick tab *S.* masv, insp, ctg	*Clv.* R, rtr dist *Fr.* compact	$Ag_3As_3S_3$	G. 5.42. Melts in can fl. BB *ch.* odor of SO_2 and As. With soda, Ag but. *A.* Argentite, Stephanite, Silver, Arsenic, Smaltite, Chloanthite, Niccolite, Galenite, Barite, Fluorite, Siderite, Pyrite, Marcasite.
Hex *H.* rhdl, dart-like, ac, clm, thick tab *S.* masv, insp, ctg	*Clv.* R, rtr dist	Ag_3SbS_3	G. ± 5.8. Melts in can fl. BB *ch.* fus with spirting to globule. Coats coal wh. With soda, but of Ag. *A.* Same as Proustite above.
Amorphous	*Fr.* cnch, comp, ethy	$CuSiO_3 2H_2O$	G. 2.1. In closed tube yields water. BB decrep and colors fl grn. With fluxes, reac for Cu. Infusible. *A.* Malachite, etc.

Name	Lustre	Color	Streak	Hardns	Tenacity
Zincite (Rothzinkerz)	sub-adm	deep red to orange-yel	brnh-yel to orange-yel	4	brittle
Cuprite (Rothkupfererz)	adm sub-met	cochineal to dark red	brnh to blood-red	4	brittle
Hauerite (Mangankies)	sub-metallic	dk rdsh-brn	brownish-red	4	brittle
Hematite (Rotheisenerz, Eisenglanz) (See I 5)	ethy to sub-met	dk rd to steel-gry	blood-red	5.5	brittle
Turgite (Hydrohämatit)	sub-met, satn, dull	rdsh-blk to rd	red	5.5	brittle
Columbite (Niobite)	metalloid-adm vitr	brnh-blk	brownish-red	6	brittle

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Chloropal (Pinguite, Gramenite, Nontronite very similar)	resinous	liver-brown	liver-brown	1	mal to sect
Torbernite (Kupferuranit, Uranglimmer in part)	001 prly, elsewhere vitr	emld-grn	pale to apple-grn	2	brit to sect

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Hex *H.* hmph *S.* masv, insp	*Clv.* bas emin, $10\bar{1}0$ smts *Fr.* coarse gran, thick shly	$(Zn,Mn)O$	G. ± 5.5. In closed tube, blkens, but resumes color on cooling. BB infus. With fluxes on plat wire, Mn reac. R F coat of ZnO, yel hot, wh on cooling. Sol in acids without effervescence. *A.* Franklinite, Calcite, Willemite.
Ism *H.* octl, cub, dodl, cap *S.* masv, insp	*Clv.* 111 dist	Cu_2O	G. ± 6. BB colors fl grn; moistened with HCl, blue. With difficulty fus. *A.* Malachite, Copper, Limonite.
Ism *H.* octl	*Clv.* cub, dist	MnS_2	G. 3.4. Closed tube, subl of S. Open tube, emits S fumes and becomes grn. BB infus. Mn reac with fluxes. *A.* Sulphur, Gypsum, Tetradymite.
Hex *H.* rhdl	*Fr.* comp, fib, stky, round gran, ethy	Fe_2O_3	G. ± 5. BB infus. *Ch.* R F becomes magn. *A.* Limonite, Göthite, Pyrolusite, Psilomelane.
? *H.* bot, stal	*Fr.* fib, stky	$Fe_4O_5(OH)_2$	G. ± 4.4.
Orm *H.* tab, ac, clm	*Clv.* 010 dist	$Fe[(Nb,Ta)O_3]_2$	G. 6. BB infusible. *A.* Beryl, in granite.

Of Yellow Streak

Amorphous *S.* massive	*Fr.* compact	$(Fe,Al)_2(SiO_3)_3.5H_2O$ (Nontronite—$Fe_2(SiO_3)_3.5H_2O$)	G. 1.75. Greasy to touch. *A.* Barite.
Ttrg *H.* scy, tab, pyr *S.* coating	*Clv.* bas perf 110 dist	$(UO_2)_2Cu(PO_4)_2.8H_2O$	G. 3.5. In closed tube yields water. In forceps fus to blkish mass and colors fl grn. With merc fus to grn bead, and with tin on coal cools to opaque red. *A.* Uraninite, Limonite, Hematite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Iodyrite (Iodsilber)	adm to res	sulph-yel	light yellow	2	mal to sect
Humboldtine (Oxalite)	none to gltg	ochre- to straw-yel	straw-yellow	2	sectile
Copiapite (Misy)	ethy to gltg	sulph-yel	light yellow	2	sectile
Realgar	res to adm	auroral red	orange-yel	2	sect to brit
Orpiment	prly on clv surf, elsewhere res	lemon-yellow	lemon-yellow	2	sectile
Sulphur	res to adm	sulph-yel to gry-brn & red	sulph- to straw-yel	2	brit to sect
Massicot	dull	yel, rdsh	same lighter	2	.....
Autunite (Kalkuranit, Uranit)	bas prly, otherwise sub-adm	citron- to sulph-yel	yellowish	2	sectile
Minium (Mennige)	faint greasy or dull	bright red	orange-yel	2.5	.....
Uranophane	vitreous	yellow	.....	2.5	.....
Xanthoconite	adm to prly	orange-yel	orange-yel	2.5	sect to brit

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Hex *H.* hmph, tab, prsm *S.* ctg	*Clv.* bas perf *Fr.* scaly	AgI	G. 5.6. Melts in can fl.
H. cap *S.* masv, ctg	*Fr.* comp, ethy	$(FeC_2O_4)_2.3H_2O$	G. ± 2.2. BB infus. Turns blk and magn.
Mcl *H.* scaly *S.* masv, ctg	*Clv.* 010 perf *Fr.* scy, ethy	$(FeOH)_2Fe_2(SO_4)_5.18H_2O$	G. 2.1. Insol in water. BB yields water, and at higher temp sulph acid. On *ch.* becomes magn. *A.* Pyrite, of which it is a product of decomposition.
Mcl *H.* short prsm, thick tab, short ac *S.* masv, insp, ctg	*Clv.* 010, bas, rtr perf *Fr.* comp, ethy	As_2S_2	G. 3.4–3.6. Melts in can fl. Combust. BB burns with blue fl and As odor. In closed tube, red subl. *A.* Arsenic, Antimonite, Pyrite, Orpiment, Barite, Calcite.
Orm *H.* short clm, lent *S.* masv, insp, lam, rnd	*Clv.* 010 perf *Fr.* short stel, scy, gran, comp	As_2S_2	G. 3.48. In closed tube yel subl, otherwise like Realgar. *A.* Antimonite, Pyrite, Barite, Calcite, Clay.
Orm *H.* pyrl *S.* masv, insp, powd, lam, rnd	*Clv.* 110 dist, 111 dist *Fr.* comp, ethy, fib	S	G. 2.072. BB burns with a blue fl. Melts in can fl. Subl. *A.* Gypsum, Calcite, Coal, Galenite, Celestine.
? *H.* masv	.....	PbO	G. 8. Does not soil.
Orm *H.* scaly, thin tab	*Clv.* bas emin, 110 perf	$(UO_2)_2Ca(PO_4)_2.8H_2O$	G. ± 3.12. Xls seem ttrg. In closed tube yields water. BB fus at 2.5 to a blkened mass. *A.* Uraninite.
S. powdery	.....	Pb_3O_4	G. 4.6. BB *ch.* in R F, but of met Pb. *A.* Galenite, Calamine, Cerussite.
Orm	.....	$Ca,U_2,Si_2,O_{12}.6H_2O$	G. 3.86.
Hex *H.* rhdl, tab *S.* insp, sph	*Clv.* in one dir	Ag_3AsS_4	G. 5.1. Melts in can fl. In closed tube at gentle heat yel color is changed to red and restored on cooling. *A.* Proustite, Barite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Xanthosiderite	slky to greasy	gold-yel	ochr-yel	2.5	.....
Crocoite (Rothbleierz, Kallochrom)	vitr to adm	hyacinth to auroral red	orange-yel	2.75	sectile
Gummite (Gummierz, Uranogummit, Urangummierz)	greasy	rdsh-yel, rdsh-brn	lemon- to orange-yel	2.75	sect to brit
Pharmacosiderite (Würfelerz)	vitreous	olive-grn to yelh-brn	yellow	2.75	rather sect
Astrophyllite (See II 5)	sub-met, prly	brnz to gold-yel	mosaic gold	3	brittle
Volborthite (Kalkvolborthite)	m.o.p.on 001 elsewhere non-met	siskin-green	sulph-yel to siskin-yel	3	.....
Pitticite (Arseneisensinter)	vitr to greasy	yelh- and rdsh-brn	ochre-yellow	3	brittle
Vanadinite	greasy	yellow-brown	light yellow	3	brittle
Endlichite	res surf of frac	deep ruby-rd	wh or yelh	†2.9	brittle
Greenockite	adamantine to greasy	honey-yellow to orange	orange-yel	3	brittle
Jarosite (Gelbeisenerz)	vitr, almost to m. o. p.	brown	ochre-yellow	3.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
? *H.* acicular	.....	$Fe_2H_4O_5$	G.
Mcl *H.* short clm, ac, dart-like	*Clv.* 110 tol dist	$PbCrO_4$	G. ± 6. In closed tube, blkens; on coal, is reduced to met Pb with deflagration. *A.* Galenite, Gold, Vauquelinite.
S. masv, insp, rnfm	*Fr.* cnch to unvn	$(Pb,Ca,Ba)SiU_3O_{12}.5H_2O$	G. ± 4.1. BB infus. *A.* Uraninite.
Ism *H.* cub	*Clv.* 100 dist	$Fe(FeOH)_3(AsO_4)_3.6H_2O$	G. ± 3. Pyroelectric. BB *ch.*, with soda, magn mass. Color of powder changed to rdsh brn by sol of caustic potash. *A.* Arsenopyrite, Scorodite.
Orm *H.* flat prsm	*Clv.* 010 perf	$(K,Na)_2H_4(Fe,Mn,Ca,Mg)_5(Zr,Si,Ti)_7O_{22}$	G. 3.35. Pleochr. in thin leaves.
S. scaly	*Clv.* perf in one dir	$(Cu,Ca)(CuOH)VO_4$	G. 3.5. BB infus. Powder mixed with soda and fus, then boiled with water, acidified with HCl, and boiled down, becomes emld-grn; diluted with water, sky blue. *A.* Pyrolusite, Sandstone.
Amorphous *S.* masv, rnd	*Fr.* cnch	$Fe_{20}(OH)_{24}(SO_4)_3[(As,P)O_4]_{10}.9H_2O$	G. 2.3. Often crackled. Fragile. (BB, see PHARMACOSIDERITE, above.) *A.* Arsenopyrite.
Hex *H.* short clm, short ac	.....	$Pb_5Cl(VO_4)_3$	G. 6.75. BB fus easily to lustrous mass. *A.* Galenite; on limestone.
Hex *H.* pyrl, hmhd	*Fr.* uneven	Ca,Pb,V,As,Cl,O	G. ± 7.
Hex *H.* rhdl, pyrl, tab *S.* small rnfm, ctg, powd	*Clv.* $10\bar{1}0$ dist, bas imperf	CdS	G. 4.8. Nearly trsp. Strong double refrac. Veined parallel to axis. BB gives SO_2 on coal and brown-red coat. Closed tube, carmine color, fading to original color on cooling. Infus. *A.* Galenite, Blende, Prehnite, Calcite.
Hex *H.* tabular *S.* massive	*Clv.* bas dist *Fr.* scaly	$(FeO)_3K(SO_4)_2.3H_2O$	G. 3.25. BB intumesces, and in R F fuses to magn but. Powder turned brnh-red by sol of potash. *A.* Hematite, Limonite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Cacoxenite	silky	ochre- to lemon-yel (stains brn)	straw-yellow	3.5	brittle
Nadorite	res to vitr	brn to yelh	yellow	3.75	.....
Pucherite	adamantine	rdsh-brn, brnh-rd	ochre-yellow	4	brittle
Sphalerite Zinc Blende, or **Blende**	adamantine	brn to rdsh-brn	straw- to Isabella-yel, partly brnh	4	brittle
Wurtzite (Strahlen-blende)	adm to m.o.p.	brown	brnh-yel	4	brittle
Zincite (Rothzinkerz)	sub-adm	orange-yel	orange-yel	4	brittle
Bastnäsite	vitr to greasy	wax-yel to brn	light yel, gry	4.25	brittle
Parisite	vitreous	brnh-yel	yelh-wh	4.5	brittle
Triplite	resinous	brown-black	pale yel gry-yel	4.5	brittle
Göthite (Nadeleisen-erz)	adm velvety silky	brown	brownish-yellow	4.5	brittle
Herderite	vitr to sub-res	yelh, grnh-wh	.....	5	.....
Durangite	vitreous	orange-red	cream-yel	5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl or Trcl *H.* capillary *S.* massive	*Fr.* short fib	$(Fe_2(OH)_3PO_4)_2.9H_2O$	G. ± 3.4. BB closed tube yields water. Fus on edges to blk slag. Colors outer fl bluh-grn. *A.* Limonite, Dufrenite.
Orm	*Clv.* 100	$PbClSbO_2$	G. 7.02. Trsl.
Orm *H.* tab, ac	*Clv.* bas perf	$BiVO_4$	G. 5.9. BB *ch.*, with S and KI, red sublimate. With mcrc in R F, grn bead. *A.* Bismite.
Ism *H.* octl, tetr, dodl *S.* masv, insp, rnfm	*Clv.* 110, perf *Fr.* gran, thin stky, shly, fib, comp	ZnS (contains often Fe and Cd, Cu, Sb, and Mn)	G. 4. Very hard to fuse. BB, open tube, SO_2. On coal, ctg of Zn and smts of Cd. *A.* Galenite, Chalcopyrite, Pyrite, Arsenopyrite, Siderite, Barite, Fluorite.
Hex *H.* rhdl, tab *S.* masv, rnd	*Clv.* prsm dist, bas less so *Fr.* fibrous	(Zn,Fe)S	G. 4. (BB, see SPHALERITE.) *A.* Blende, Galenite, Siderite.
Hex *H.* hmph *S.* masv, insp	*Clv.* bas emin, $10\bar{1}0$ smts *Fr.* coarse gran, thick shly	(Zn,Mn)O	G. ± 5.5. BB infus. *A.* Franklinite, Calcite, Willemite.
Massive	.....	Ce,La,Di,C,O	G. 4.93.
Hex *H.* pyrl	*Clv.* bas *Fr.* small cnch	Ca,Ce,La,Di,C,F,O	G. 4.358.
Mcl *S.* massive	*Clv.* dist in two dir *Fr.* thick shly	(Fe,Mn)PO_4(Fe,Mn)F	G. 4. Fus easily to blk magn globule. With H_2SO_4 evolves HF. Soluble in HCl. *A.* Apatite, Beryl. In granite.
Orm *H.* ac, scy, cap *S.* masv, rounded	*Clv.* 010 perf *Fr.* fib, stky, scy	FeO.OH	G. 4. BB iron reac. *A.* Limonite.
Orm *H.* pyrl	*Clv.* prsm *Fr.* sub-cnch	Ca,Be(OH,F)PO_4	G. ± 3.
Mcl	*Clv.* prsm *Fr.* unvn	Na(AlF)AsO_4	G. ± 4.

Name	Lustre	Color	Streak	Hardns	Tenacity
Limonite	greasy to vitr, also silky	brown-yellow	brn- to ochre-yel	5.5	brittle
Microlite	resinous	pale yel to brn	pale yel to brn	5.5	brittle
Basaltic Hornblende	vitreous	brn-blk to pitch-blk	Isabella- to ochre-yel	5.5	brittle
Roepperite	vitr to unct	pl yel to dk grn	yel to rd-gry	5.75	.....
Rutile (See II 2)	metalloid adamantine	black-brown	light yellow	6.5	brittle
Cassiterite (Zinnerz)	adamantine, slightly met	brown to black	Isabella-yel	6.5	brittle
Ferruginous Quartz	vitreous	ochre-yellow to brown	light ochre-yel	7	brittle

5

Celadonite	earthy (?)	deep olive-grn	olive-green	< 1	very soft
Chloropal (Pinguite, Nontronite very similar)	waxy	finch-green	yel to finch-green	1	sect to mal

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Crystalline *S.* masv, insp, rnfm, rnd, powd	*Fr.* stky, fib, ethy, shly, comp	$Fe_4O_3(OH)_6$	G. ± 3.7. BB iron reac. *A.* Hematite, Pyrolusite, Psilomelane, Barite, Chalcedony.
Ism *H.* octl	*Fr.* cnch	$Ca(Mn,Fe,Mg)_2(Ta,Nb)_2O_7$	G. 5.5. Alkalies and F present.
Mcl *H.* prsm, ac *S.* masv, insp	*Clv.* 110, hly perf *Fr.* comp, stky	$(Mg,Fe)_2Al_2(AlO_3)_2(SiO_3)_2$	G. ± 3.1. Unacted on by acids. *A.* Augite in Basalt, Phonolite, etc.
Orm	*Clv.* 010, 001	$(Fe,Mn,Zn,Mg)_2SiO_4$	G. ± 4. Slightly magn.
Ttrg *H.* pyrl, clm, ac *S.* masv, insp	*Clv.* 100 perf, 110 dist *Fr.* thick gran	$TiTiO_4$	G. 4. (BB, see II 2.)
Ttrg *H.* clm, ac, pyrl *S.* masv, insp	*Clv.* 100 perf, 110 dist *Fr.* compact, fib, gran	$SnSnO_4$	G. ± 6.8. Opaque. BB infus. Coal with soda met tin. *A.* Arsenopyrite, Wolframite, Molybdenite, Bismuth, Fluorite, Apatite, Scheelite, Lepidolite, Blende, Chalcopyrite, Pyroxene, Amphibole.
Hex *H.* clm, ac *S.* masv, insp	*Fr.* comp, gran, stky	SiO_2 (with yellow or red oxide of iron)	G. 2.7. BB infus. Borax dissolves slowly to clear glass-green when hot. Melts with soda with intumescence. *A.* Limonite.

Of Green Streak

Amorphous	.....	K,Na,H,Ca,Mg,Mn,Al,Fe,Si,O	G.
Amorphous *S.* massive	*Fr.* on large surfaces cnch to unvn ; on small surf spln, ethy	$(Fe,Al)_2(SiO_3)_3.5H_2O$	G. ± 1.8. Greasy feel. Closed tube yields water. BB infus, turns blk, and becomes magn. Completely decomp by HCl with sep of pulv SiO_2. *A.* Barite.

Name .	Lustre	Color	Streak	Hardns	Tenacity
Bromargyrite (Bromsilber, Embolite, Chlorbromsilber)	adamantine	green, yellow	yelh to siskin-green	1.5	malleable
Prochlorite	feebly prly	green	clss or grnh	1.5	flex not elas
Ehlite (Prasin in part)	cmn, m. o. p.	emld-grn	pale green	2	sect to brit
Torbernite (Kupferuranit) (See II 4)	common, on bas mother-of-pearl	emld-, vrdg-, apple-grn	pale green, apple-green	2	brittle to sectile
Genthite (Nickel Sepiolith)	feebly res to lustreless	apple-green to emerald-green	pale green, apple-green	2	sectile
Glauconite	smwh pearly	deep grn to wh	grnh-wh, clss	2.25	flex little elas
Annabergite (Nickelblüthe)	gltg to lustreless	apple-green	pale green, apple-green	2.25	sectile to brittle
Clinochlore	clv surf prly	grn, yel, rose, wh	grnh-wh to clss	2.25	mild, flex
Garnierite (Numäit)	gltg to lustreless	apple-green	pale green	2.5	brittle
Ripidolite (Chlorite Group)	of clv face smwh prly	deep grass- to olive-grn	gray-grn to clss	2.5	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* cub, octl *S.* masv, lam, ctg	*Fr.* masv, spln	AgBr	G. 5.9. Often gray tarnish. Melts in can fl. In closed tube fus without decomp. Placed on strip of zinc and moistened, swells up, turns blk, and is reduced to met Ag, which gives lustre on pressure with knife-blade. *A.* Native Silver, Calcite.
Mcl	*Clv.* bas emin	$H_4(Mg,Fe)_2Si_2O_9$	G. ± 2.87. Trsl to opq.
H. scaly *S.* masv, insp, rnfm, wrty	*Clv.* perf in one plane *Fr.* scaly, rdl	$Cu(CuOH)_4(PO_4)_2 H_2O$	G. 4. BB gives water and turns blk; decrepit. Fus to but holding Cu. *A.* Pseudomalachite.
Ttrg *H.* scy, tab, pyrl	*Clv.* bas perf, 110 dist	$(UO_2)_2Cu(PO_4)_2.8H_2O$	G. ± 3.5. In closed tube yields water. In forceps fus to blk mass and colors fl grn. *A.* Uraninite, Limonite, Hematite.
Amorphous *S.* coating	*Fr.* cnch	$(Mg,Ni)_2H_4Si_2O_{10}$	G. 2.4. Smts so soft as to be polished by the nail and fall to pieces in water. Closed tube, blkens and gives water. BB almost infus. *A.* Chromite, Serpentine.
Mcl	*Clv.* bas very perf	$H_8Mg_5Al_2Si_3O_{18}$	G. ± 2.7.
Mcl *H.* capillary *S.* masv, insp, ctg	*Fr.* comp, ethy	$Ni_3(AsO_4)_2.8H_2O$	G. 3. BB fus easily, with As odor, and yields met but, which with borax gives first blue cobalt glass, and later violet to reddish-brown of Ni. *A.* Chloanthite, Niccolite, Gersdorffite, Siderite, Barite.
Mcl *H.* hex, tab	*Clv.* bas perf *Fr.* unvn	$H_8(Al,Fe,Cr)_2 (Mg,Fe)_5Si_3O_{18}$	G. 2.7.
Amorphous	*Fr.* massive	$(Ni,Mg)H_2SiO_4$	G. 2.27. Adheres to tongue. In matrass gives water, becoming gray. With borax, nickel bead. Immersion in water, decrep, the fragments having cnch frac. *A.* Chromite, Serpentine, Steatite.
Mcl *H.* tab, fol, scy *S.* masv, insp, rnfm, ctg	*Clv.* bas emin *Fr.* scy, comp, ethy	$Al_3(Fe,Mg)_5H_9Si_3O_{20}$	G. ± 2.7. Xls. seem hex. BB yields water In platinum forceps whitens, and fus with difficulty on edges. Partially gelatinizes with acids. *A.* Talc, Dolomite, Magnetite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Thuringite	pearly	olive-green	green	2.5	.....
Cronstedtite (Chamosit)	vitreous	coal-black to brnh-blk	dark olive-grn	2.5	brittle
Tyrolite (Kupfer-schaum)	bas pearly	bluish-green	bluh, vrdg-grn	2.5	sectile
Chalcophyllite (Kupfer glimmer)	bas pearly	emld- to vrdg-grn	pale green	2.5	brittle
Clinoclasite (Strahlerz)	bas pearly	bluh-green to grnh-blk, on surf blk	bluh-green	2.75	sect to brit
Liroconite (Linsenerz)	vitr to greasy	bluish-green	bluish-green	2.75	brit to sect
Astrophyllite (See II 4)	sub-met, prly	brnz- to gold-yel	mosaic gold	3	brittle
Euchroite	vitreous	emld-grn	bluish-green	3	brittle
Dufrenite (Kraurite, Grüneisenerz)	vitr to greasy, on 010 prly	dark leek-grn to grnh-blk	yelh to sis-kin-green	3.25	very brittle
Zaratite (Emerald Nickel, Nickel Smaragd)	vitreous	emld-grn	paler green	3.25	brittle
Chrysocolla (Kieselkup-fererz)	vitreous, unctuous to lustreless	green	bluish-green	3.5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Massive	*Clv.* in one plane	$H_{18}Fe_8(Al,Fe)_8Si_6O_{41}$	G. 3.17. Greasy feel.
Hex *H.* rhdl, clm, fib *S.* masv, rnfm, cyln	*Clv.* bas hly perfect	$Fe_2(Fe,Mg)_3H_6Si_2O_{13}$	G. ± 3.3. BB froths and fus on edges. Gelatinizes in concen HCl. *A.* Limonite, Calcite.
H. fol, scy *S.* massive	*Clv.* perf in one plane *Fr.* scy, rdl	$Cu(CuOH)_4(AsO_4)_2.7H_2O$	G. 3. Decrep, yielding much water. *Ch.* fus with As odor. R F globules of Cu. *A.* Tetrahedrite, Malachite, Azurite.
Hex *H.* rhdl, scy, fol, tab	*Clv.* bas hly perf	$(Cu(OH)_2(CuOH)_3AsO_4)_2.7H_2O$	G. ± 2.5. Decrepitates, yielding much water. Soluble in amn. *A.* Chalcopyrite Cuprite.
Mcl *H.* short ac, short clm, thick tab, chisel-shaped *S.* rounded	*Clv.* bas perf, crumpled, fol *Fr.* radial	$(CuOH_3)AsO_4$	G. ± 4.2. Gives water. BB fus, fl bluish-grn. *Ch.* with soda, button of copper. Sol in amn. *A.* Chalcopyrite.
Mcl *H.* short clm, blunt pyrl, lent	....	$[(Al_4Cu_9(OH)]_{15}(AsO_4)_5.20H_2O$	G. 2.8. In closed tube gives much water and turns grn. BB cracks open, but does not decrep. Sol in amn. *A.* Chalcopyrite.
Orm *H.* flat prsm	*Clv.* 010 perf	$(K,Na)_2(Fe,Mn,Ca,Mg)_5(Zr,Si,Ti)_7O_{22}$	G. 3.35. Pleochroic in thin leaves
Orm *H.* tab, clm	*Clv.* 110	$(CuOH)CuAsO_4.3H_2O$	G. ± 3.4. Gives water. (For other reactions, see OLIVENITE.) *A.* Olivenite, Asbolite.
Orm *H.* cuboid *S.* reniform	*Clv.* 010 perf *Fr.* radial	$Fe_2(OH)_3PO_4$	G. ± 3.3. In closed tube gives water. BB fus easily to slag. Xls rare and small. *A.* Limonite, Cacoxenite.
Amorphous	.....	$2Ni(OH)_2NiCO_3.4H_2O$	G. 2.57. Stalactitic. Minute mammillary. In closed tube yields water and CO_2. BB infus. Borax O F vilt bead hot, and rdsh-brn cold. R F grn, opaque. *A.* Chromite, Serpentine.
Amorphous	*Fr.* cnch to irreg	$CuSiO_3.2H_2O$	G. 2.1. (See II 2, 3.)

Name	Lustre	Color	Streak	Hardns	Tenacity
Libethenite (Prasin)	greasy to vitreous	leek-green to blkh-grn	olive-green to bright green	3.5	brittle
Olivenite (Pharmakochalzit)	vitreous, unctuous, silky	leek-, olive-, pistachio-green	olive-green	3.5	brittle
Malachite	vitr, prly, & silky	emld-grn, on 001 grnh-blk	emld- to vrdg-green	3.5	brittle
Brochantite	vitreous	emerald-green	emld- to vrdg-green	3.5	brittle
Alabandite (Manganblende)	sub-metallic	iron-black	dark green to gray	3.75	brit to sect
Atacamite (Halochalzit)	vitr to unct	emld- to leek-grn	emld- to light vrdg-green	3.75	brittle
Dioptase (Kupfersmaragd)	vitreous	emld-grn	vrdg-grn to sky-blu	4.75	brittle
Pseudo-Malachite (Phosphorchalcit)	unct to vitr	blkh, emld-grn, vrdg-grn	emld- to vrdg-grn	5	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *H.* pyrl	.....	$(CuOH)CuPO_4$	G. 3.7. In closed tube yields water and turns blk. BB fus, colors fl grn, and R F with soda yields met Cu. *A.* Malachite, Cuprite, Limonite.
Orm *H.* short ac, short clm, cap *S.* masv, rnfm	*Fr.* fibrous	$(CuOH)CuAsO_4$	G. ± 4.3. In closed tube gives water. BB fus, coloring fl bluh grn, and on cooling fused mass is xln. *Ch.* with soda yields Cu. Sol in amn. *A.* Chalcopyrite, Asbolite, Enargite.
Mcl *H.* cap, ac *S.* masv, insp, rnfm, powd, ctg	*Clv.* bas perf, 010 less so *Fr.* fib, comp. ethy, scy, shly	$(CuOH)_2CO_3$	G. ± 3.8. In closed tube blkens and yields water. BB fus, coloring fl emld-grn. *Ch.* in R F, reduced to Cu. Effervesces with acids. *A.* Chalcopyrite, Tetrahedrite, Chalcocite, Cuprite, Copper, Limonite, Hematite, Azurite.
Orm *H.* short ac *S.* reniform	*Clv.* 010 very perf *Fr.* fibrous	$2Cu(OH)_2(CuOH)_2SO_4$	G. ± 3.8. Xls small. In matrass yields water and turns blkh-brn. Sol in amn. BB, mixed with *ch.*, powder gives SO_2. Melts on coal in R F, yielding but of Cu. *A.* Chalcopyrite, Malachite, Limonite.
Ism *H.* octl *S.* masv, insp	*Clv.* 100 perf *Fr.* compact	MnS	G. ± 4. Opaque. Surface dull and dk brn. BB fus with much difficulty. Unchanged in closed tube. With fluxes, reac for Mn. Sol in HCl with evolution of H_2S. *A.* Blende, Rhodochrosite.
Orm *H.* ac, prsm, thick tab *S.* masv, insp, powd	*Clv.* 010 dist, bas obs *Fr.* radial	$Cu(OH)_2Cu(OH)Cl$	G. 4.1. In closed tube gives off water. BB az-blue fl. *Ch.* with soda, met Cu. Sol in amn. *A.* Limonite, Hematite.
Hex *H.* rhdl, short columnar *S.* interspersed	*Clv.* R perf *Fr.* comp	CuH_2SiO_4	G. ± 3.2. In closed tube blkens and yields water. BB blkens without fus, and colors fl emld-grn. Gelatinizes with acids. *A.* Calcite.
(?) *H.* clm *S.* masv, insp	*Fr.* compact, fib	$(Cu.OH)_3PO_4$	G. ± 4.2. Yields water and turns blk. BB fus, fl grn, with soda on coal met Cu. Sparingly sol in amn. *A.* Malachite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Yttrotantalite	sub-met, vitr, unct	black to yel	gry to clss	5.25	.....
Pyroxene (Augite)	vitreous	blkh-grn, grnh-blk	gryh-grn	5.5	brittle
Hornblende (Amphibole)	vitreous, in part pearly	blkh-grn to velvet-blk	gryh-grn	5.5	brittle
Lievrite (Ilvaite)	unctuous	black	dark green	5.75	brittle
Spinel (Var. Pleonast)	vitreous to greasy	blk to grn	gryh-grn	7.5	brittle
Hercynite	vitr to dull	black	gray-green	7.75	.....

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Vivianite (Blaueisenerz)	010 metallic pearly, other faces vitreous	indigo-blue to blkh-grn	light indigo-blue	2.5	sectile
Liroconite (Linsenerz)	vitr to greasy	sky-blue to vrdg-grn	greenish-blue	2.75	brit to sect
Linarite (Bleilasur)	adm to vitr	deep az-blue	pale blue	2.75	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *H.* prsm	*Clv.* 010 *Fr.* sm cnch	Ca,Fe,H,U,Ce,Er,Y, Sn,W,Nb,Ta	G. ± 5.7.
Mcl *H.* short clm, thick tab *S.* masv, insp	*Clv.* 110 dist, 110 ∧ 110 87° *Fr.* granular	$Mg,Ca(SiO_3)_2$	G. 3.3. *A.* Amphibole, Garnet, Calcite, Magnetite, Pyrite, Blende, Galenite.
Mcl *H.* short clm, short ac *S.* masv, insp	*Clv.* 110 perf, 110 ∧ 110 124° *Fr.* fib, stalky, granular	$(Mg,Fe)_2Ca(SiO_3)_4$	G. ± 3.1. *A.* Pyroxene, and same as preceding.
Orm *H.* clm, ac *S.* insp, masv	*Clv.* 010 distinct *Fr.* fibrous, stalky	$(FeOH)Fe_2Ca(SiO_4)_2$	G. 3.9. BB fus to blk magn bead. Gelatinizes with HCl. *A.* Pyroxene.
Ism *H.* octahedral *S.* insp, masv	*Fr.* comp, cnch	$(Mg,Fe)[(Al,Fe)O_2]_2$	G. ± 4.2. Opaque. BB infus. *A.* Magnetite, Calcite, in basalt.
Ism	.....	$FeAl_2O_4$	G. ± 3.93.

Of Blue Streak

Mcl *H.* ac, scy *S.* masv, insp, powd	*Clv.* 010 hly perf *Fr.* rdl, ethy	$Fe_3(PO_4)_2.8H_2O$	G. ± 2.5. In closed tube yields neutral water, whitens and exfoliates. BB fus, coloring fl bluh-grn to gry; blk met globule. *A.* Limonite, Pyrite, Magnetopyrite, Clay, Peat.
Mcl *H.* short clm, blunt pyrl, lent	.....	$[Al_4Cu_9(OH)]_{15}(AsO_4)_5.20H_2O$. Part of As replaced by P.	G. 2.8. In closed tube yields much water and turns grn. BB cracks open but does not decrep. Sol in amn. *A.* Tetrahedrite.
Mcl *H.* ac, tab	*Clv.* 100 very perf 001 dist	$[(Pb,Cu)OH]_2SO_4$	G. ± 5.4. In closed tube yields water and loses color. BB fus easily to a pearl, and in R F yields met but, which coats *ch.* with PbO. On fus this with boric acid Cu is obtained. With soda, hepar reac. Decomp by HNO_3, leaving wh $PbSO_4$. *A.* Chalcopyrite, Galenite, Cerussite.

Name	Lustre	Color	Streak	Hardns	Tenacity
Azurite (Kupferlasur)	vitr or adm	azure-blue blkh & smalt-blue	smalt-blue	3.75	brittle
Chrysocolla	vitr, unct to lustreless	sky-blue	smalt-blue	3.5	brittle
Dioptase (Kupfer-smaragd)	vitreous	emld-grn	sky-blue to vrdg-grn	4.75	brittle
Lapis Lazuli (Lasurstein, Lasurite)	greasy to vitr	azure-blue	smalt- to pale blue	5.5	brittle
Glaucophane	vitr to prly	blu-gry, blk	gry-blue	6.25	.....

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl *H.* thick & thin tab, ac *S.* masv, insp, rnd, ctg, powd	*Clv.* 021 rather perfect, 100 less distinct *Fr.* rdl, comp, ethy	$(Cu.OH)_2Cu(CO_3)_2$	G. ± 3.7. BB, see MALACHITE, II 5.
Amorphous	*Fr.* cnch to unvn	$CuSiO_3.2H_2O$	G. ± 2.1. (See II 2.) Decomp by acids without gelatinizing.
Hex	*Clv.* R perf	CuH_2SiO_4	G. ± 3.2. (See II 5.)
Ism *H.* dodl *S.* masv, insp	*Fr.* masv, fn-gr	$Na_4(NaS_3.Al)Al_3(SiO_4)_3$	G. ± 2.3. Xls very rare. In closed tube gives off water, and that from Chili glows with beetle-grn light, but color remains blue. Fus with intumescence to wh glass, decomp by HCl, with sep of gelatinous SiO_2 and evolution of H_2S. *A.* Pyrite Calcite. (*Never Quarts.*)
Mcl	*Clv.* 110 perf	Na,Ca,Mg,Mn,Fe,Al, Si	G. 3.1.

III MINERALS OF NON-

AND OF WHITE OR

1

Name	Lustre	Color	Hardns	Tenacity
Petroleum (Erdöl, Steinöl)	.....	blk, brn, yel, wh	.....	.....
Ozocerite (Mineral wax)	unctuous	brown, yellow	1	mal, waxy
Talc (Steatite)	pearly to greasy	white, light green	1	very sect to mal
Roscoelite	pearly	dark brn to grnh	±1	soft
Kaolinite (Porcelain earth, Nacrite allied)	on base pearly in xls, lustreless	white	1	sectile
Bismite (Wismutocker)	adm to dull ethy	grn-yel to gry-wh	.....	pulverulent
Aluminite	gltg to dull ethy	white	1	sect, mal

METALLIC LUSTRE

LIGHT GRAY STREAK

Very Sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
.....	.....	A mixture of the higher members of the Paraffine series C_nH_{2n+2}	G. 0.6 to 0.75. Liquid, saturating sandstones and other sedimentary rocks. Inflammable. Odorous.
.....	.....	" " "	G. 1. Solid. Strong smell. Waxy. Sticky. Melts in boiling water. Burns with bright fl. *A*. Clay, sandstone, rock salt.
Mcl (?) *H*. scy, fol *S*. masv	*Clv*. bas, perf *Fr*. thin shly, scy, comp, spln	$Mg_3H_2Si_4O_{12}$	G. ± 2.7. Very greasy to touch. In closed tube, when intensely heated, most var yield water. BB fus on very thin edges to white enamel. With cobalt sol a pl rd color. Not decomp by acids. *A*. Actinolite, Chlorite, Dolomite, Magnesite, Apatite, Magnetite, Pyrite.
? *H*. In scales	Micaceous	K, Na, Li, H, Al, Mn, Fe, Mg, Ca, V, Si, O	G. ± 2.93.
Mcl *H*. scaly *S*. masv, ctg	*Clv*. bas perf *Fr*. fn scy, ethy	$Al_2H_4Si_2O_9$	G. ± 2.5. Opaque. Nacrite greasy, Kaolin chalky feel. Becomes plastic in water. BB infus. *A*. Galenite, Blende, Siderite, Lignite, Cassiterite.
Orm (?) *H*. prsm (art)	*Fr*. earthy	Bi_2O_3	G. 4.361.
Mcl (?)	*Fr*. earthy	$Al_2(OH)_4SO_4.7H_2O$	G. ± 2.6. In closed tube yields much water, which at high temp becomes acid. With cobalt sol, fine blue color. With soda, hepar reac. Sol in acids. BB infus. *A*. Clay, Marl, Gypsum.

Name	Lustre	Color	Hardns	Tenacity
Pickeringite	silky	wh, yel, red	1	.....
Ulexite (Boronatrocalcit)	silky	white	1	.....
Tungstite	earthy	bright yel, yelh-grn	±1	ethy, pulv
Smectite (Malthazite, Montmorillonit)	waxy	grnh-gray (Montm. rose-red)	1	sect to mal
Natron	vitr to earthy	wh, all colors	1.25	brittle
Thermonatrite	vitreous	wh, gry, yel	1.25	smwh sect
Pyrophyllite (Agalmatolite)	pearly	wh, apple-grn, yelh	1.5	sectile
Jefferisite	clv surf pearly	dark brnh-yel, light yel in trsm light	1.5	flexible
Cerargyrite (Hornsilver, Chlorargyrite, Silberhornerz)	res to adm	gry, gry-grn, brn, streak shining	1.5	malleable
Bromyrite (Bromargyrite, Bromsilber)	adm, splendent	bright yel to amber, slightly grnh	1.5	sectile
Embolite	" " "	" " "	"	"
Calomel (Quecksilberhornerz)	adamantine	wh, gry, brn	1.5	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl (?)	.....	$MgAl_3(SO_4)_4(H_2O)_{22}$	G. 1.73. Taste bit. astring.
S. in rnd masses, fib, ac	.....	$CaNaB_5O_9.6H_2O$	G. 1.6. *A.* Anhydrite, Gypsum.
Orm	*Fr.* earthy	WO_3	G. 6.35.
Amorphous	*Fr.* cnch to unvn, comp, spln	$H_2Al_2Si_4O_{12}+xH_2O$	G. ± 2. Soapy feel. BB Malthazite is infus, but Smectite, owing to impurities, fus easily. Decomp by HCl.
Orm	*Clv.* basal	$Na_2CO_3(H_2O)_{10}$	G. 1.44. Alkaline taste.
Orm	*Clv.* imp	$Na_2CO_3H_2O$	G. 1.55. Alkaline taste.
Orm *H.* scaly *S.* masv, lamel	*Clv.* bas, emin *Fr.* broad stky, scy, comp	$HAlSi_2O_6$	G. ± 2.8. Very greasy to touch. Yields water. BB whitens and fuses with difficulty on edges. Radial var exfol and swell up very much. With cobalt solution blue. *A.* Cyanite.
? *H.* broad plates	*Clv.* bas, emin	$(Al,Fe)_4Mg_4H_{12}Si_5O_{26}$	G. 2.3.
Ism *H.* cub *S.* masv, lam, ctg	*Clv.* none *Fr.* comp, fib	AgCl	G. ± 5.4. Fuses without decr in can fl. BB on coal, but of met Ag. In bead of mcrc, saturated with CuO, gives intensely blue fl. On zinc and moistened with water swells up, turns blk, and is reduced to met Ag, whose lustre appears on pressing with a knife. Sol in amn. *A.* Native Silver, Calcite, Limonite.
Ism *H.* cub, octl *S.* masv, lam, ctg	*Fr.* comp, fib	AgBr	G. 5.9. In closed tube and with met Zn behaves like Cerargyrite. *A.* Native Silver, Calcite.
" "	" "	Ag_2ClBr	
Ttrg *H.* pyrl, thick tab, short ac *S.* insp, ctg	*Clv.* 100 perf *Fr.* comp	Hg_2Cl_2	G. 6.5. Xls very small. Subl. Vol, giving wh subl. Blkens with alkalies. *A.* Cinnabar, Mercury.

Name	Lustre	Color	Hardns	Tenacity
Sassolite (Boric acid)	on base pearly	white, pale yellow	1.5	sectile
Molybdite	silky to adm	pale yellow	±1.5	.....
Sal Ammoniac (Salmiak)	greasy to vitr	white, yellow	1.75	sectile
Soda Nitre (Chili Nitre, Natronsalpeter)	vitreous	white	1.75	sect to brittle
Mirabilite (Glauber's Salt, Exanthalit)	vitreous	white	1.75	sectile
Tellurite	sub adm	wh to yelh	2	flexible
Halloysite (Bol. Variety Kaolinite)	resinous	white, yellow, red	2	sect to brittle
Cotunnite	adm to pearly	wh, yelh, grnh	2	soft
Copalite (Retinite, Rhetinit)	resinous	yel, brn, gray	2	sect to brittle
Kalinite (Alum, Potash Alum)	vitreous	white	2	brittle to sectile
Nitre (Saltpeter)	vitreous	white	2	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Trcl *H.* scy, cap *S.* incrusted	*Clv.* basal, very perf *Fr.* scy, fib	$(OH)_3B$	G. ± 1.5. Greasy to touch. With difficulty sol in water. In closed tube gives water. BB fus on wire to clear bead, and tinges fl yelh-grn. *A.* Native Sulphur.
Orm	*Clv.* basal	MoO_3	G. 4.5.
Ism *H.* trpz, octl, cub *S.* incrs, ctgs	*Fr.* fib, ethy	NH_4Cl	G. 1.5. Taste astringent. Sub in tube. Heated with $Ca(OH)_2$ gives off amn. Dissolves readily in water, and sol precip AgCl when added to $AgNO_3$ in sol. *A.* Lava, clay, coal.
Hex *H.* rhdl *S.* massive	*Clv.* R, perfect *Fr.* granular	$NaNO_3$	G. ± 2.1. Taste cooling and bitter. Sol in water. Deflag on coal. Melts in can fl, which it colors Na yel. *A.* Halite.
Mcl *S.* in efflorescent crusts	*Clv.* 100, perf	$Na_2SO_4.10H_2O$	G. 1.5. Cooling taste, then saline and bitter. Fuses. Yields much water. Dissolves easily in water, and sol precip $BaCl_2$ sol. Colors fl yel. *A.* Efflorescence at Carlsbad and other thermal springs, caverns in Hawaii.
Orm	*Clv.* 010, perf	TeO_2	G. 5.9. Trsp to trsl.
Amorphous *S.* masv, insp, lam	*Fr.* comp	$Al_2H_4Si_2O_9.xH_2O$	G. 2.5. Infus. Blue with Co sol. *A.* Basalt, sandstone.
Orm *H.* ac	.....	$PbCl_2$	G. 5.25.
Amorphous *S.* masv, insp, nod	*Fr.* comp, ethy	$C_{12}H_{18}O$	G. 1.01. Melts in can fl. Vol by gentle heat. Burns with yel fl and much smoke. Emits res odor when broken. *A.* Lignite.
Ism *H.* octl, cub *S.* efflorescence	*Clv.* 111, obs	$KAl(SO_4)_2.12H_2O$	G. 1.75. Sol in water. Alum taste. BB fus in its water of xlization and froths. With Co sol, intense blue, and with soda, hepar reac. *A.* Lava, coal.
Orm *H.* ac, cap *S.* flaky, ctg	*Clv.* 110 and 010, obs	KNO_3	G. 2. Taste saline and cooling. Deflag vividly on burning coals, and detonates with combustibles. Colors fl violet. *A.* Limestone caves.

Name	Lustre	Color	Hardns	Tenacity
Chrysotile (Serpentine Asbestus)	metallic, silky	green, brown	2	sect to brittle
Hydrotalcite	pearly	white	2	.....
Gypsum	vitreous, silky, 010 pearly	wh, gry, yel, rd, brn	2	sect to brittle
Melanterite (Copperas, Green Stone, Iron Vitriol, Green Vitriol)	vitreous	grn, effloresces to wh	2	brittle
Alunogen (Keramohalite, Haarsalz)	silky, pearly	wh, partly yelh	2	sectile
Aurichalcite (Cupreous Hydrozincite, Messingblüthe)	pearly	grnh-blue, bluh-grn	2	sectile
Brucite	base pearly	white	2	sectile
Thomsenolite	vitreous	clss, rdsh-wh, wh	2	brittle
Sulphur	adm, res	yel, gray, brn	2	brittle to sectile
Struvite	vitreous	yelh to brn-wh	2	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *S.* lamellar	*Fr.* fib	$H_4(MgFe)_3Si_2O_9$	G. 2.2. Delicately fib, the fibres easily separating. *A.* Serpentine.
Hex *H.* lam	*Fr.* fib	Mg,Al,H,O	G. ± 2.06. Trsl to trsp. Greasy feel.
Mcl *H.* clm, ac, tab, scy, lent *S.* masv, lam, powd	*Clv.* 010, perf 111 and 100 obs *Fr.* gran, fib, scy, ethy, comp	$CaSO_4.2H_2O$	G. 2.3. Very little sol in water. Yields water and becomes opaque. BB melts to a but. *A.* Clay, marl, Native Sulphur, also as new formation on metal veins.
Mcl *H.* cap, ac, clm *S.* rnfm, masv, lam	*Clv.* 001, obs *Fr.* comp, fib	$FeSO_4.7H_2O$	G. 1.8. Dissolves in water. BB yields water, and becomes brn and finally blk and magn. With fluxes, reacts for Fe. Taste harsh, astring, and met. *A.* Alunogen, Pyrite.
H. cap, ac, scy *S.* rnfm, bot, lam, incr	*Clv.* perf in one dir *Fr.* fib, scy, gran	$Al_2(SO_4)_3.18H_2O$	G. ± 1.7. Taste astring. Yields water and SO_2 in closed tube. Blue with Co sol. When deprived of water, infus. *A.* Clay, Lignite, Pyrite, Alum, coal.
H. ac, scy *S.* drusy incr, masv	*Clv.* perf in one dir *Fr.* fib, scy	$2(Zn,Cu)(OH)_2.((Zn,Cu)OH)_2CO_3$	G. 3.7. Sol with effervescence in HCl. *A.* Limonite, Chalcopyrite, Zincblende.
Hex *H.* rhdl, tab scy *S.* massive	*Clv.* bas, perf *Fr.* shly, stky, fib	$Mg(OH)_2$	G. 2.3. Greasy to touch. Yields water, becoming opaque. BB infus, but vividly incandescent. With Co sol, vilt-rd. Sol in acids. *A.* Serpentine limestone, Chromite.
Mcl *H.* prsm, pyrl	*Clv.* bas, perf, 010	$NaCaAlF_6.H_2O$	G. 2.97. Trsp to trsl.
Orm *H.* pyramidal *S.* masv, lam, rnd, crust-like, powd, insp	*Clv.* 001, 111 } obs	S	G. 2. Melts and ignites in can fl. (See II. 4.)
Orm *H.* hmph	*Clv.* bas, perf *Fr.* cnch	$NH_4MgPO_4(H_2O)_6$	G. ± 1.67. BB H_2O and NH_3.

Name	Lustre	Color	Hardns	Tenacity
Trona (Natron, Urao)	vitreous	white	2	sectile
Sepiolite (Meerschaum)	dull, brightens in streak	wh, partly yelh	2.25	sectile
Borax (Tinkal)	res to vitr	wh, in part gry	2.25	brittle to sectile
Nantokite	adamantine	clss to white	2.25	.....
Goslarite (White Vitriol, Zinkvitriol)	vitreous	white, gray	2.25	brittle
Epsomite (Bittersalz)	vitreous	wh, pl yel, pl red	2.25	brittle
Fibroferrite	silky, pearly	pl yel to wh	±2.25	brittle
Annabergite (Nickelblüthe)	glinting to dull	apple-green	2.25	sect to brit
Hydrozincite (See later)	dull	wh, gryh, yelh	2.25	.....
Pharmacolite (Arsenblüthe)	vitr, prly, silky	white	2.25	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl *H.* clm, fib *S.* massive	*Clv.* 100, perf	$HNa_2(CO_3)_2.2H_2O$	G. 1.4. Sol in water. Alkaline reac and taste. Only occurs in powder. Colors fl intensely yel. *A.* Mirabilite, Halite.
Amorphous *S.* masv, nod	*Fr.* in large masses, cnch, in small, ethy, comp	$H_4Mg_2Si_3O_{10}$	G. 0.988–1.279. Can be cut by thumb-nail. Unct to touch; adhering to the tongue. BB yields water and then burnt odor. Vilt-rd with Co sol. *A.* Chalcedony, Opal, Chlorite.
Mcl *H.* short clm, tab	*Clv.* 010, obs	$Na_2B_4O_7.10H_2O$	G. 1.7. Sol in water. BB puffs up and fus to a clear bead called borax glass. Fused with fluorspar and $KHSO_4$ colors fl grn. *A.* In waters of salt lake of Thibet and in mineral springs of Chambly (Canada East) and Borax Lake, Cal., and the Tuscan lagoons.
Ism *H.* gran, masv	*Clv.* cub *Fr.* cnch	Cu_2Cl_2	G. 3.93. Trsp to trsl.
Orm *H.* clm, ac *S.* rnfm, incr	*Clv.* 010, obs *Fr.* granular	$ZnSO_4.7H_2O$	G. 2. Xls rare. Sol in water. Taste astring, met, and nauseous. Yields water. BB *ch.* with soda, a coat of ZnO, and hepar reac. *A.* Blende.
Orm *H.* ac, cap *S.* incr, ctg	*Clv.* 010, dist *Fr.* gran, fib, ethy.	$MgSO_4.7H_2O$	G. 1.7. Xls rare. Sol in water. Taste bit and saline. Melts in can fl. *A.* Marl, Pyrite.
Mcl (?)	*Fr.* fib	$2Fe(OH)SO_4.9H_2O$	G. ± 1.85. Trsl.
Mcl *H.* cap, ac, scy *S.* ctg, masv, insp	*Clv.* 010, perf *Fr.* earthy	$Ni_3(AsO_4)_2.8H_2O$	G. 3. BB, see II. 5.
? *S.* masv	*Fr.* uneven	$Zn(OH)_2(ZnOH)_2CO_3$	G. ± 3.7.
Mcl *H.* cap, ac *S.* sphl, bot, hepatic, incr, ctg	*Clv.* 010, perf *Fr.* fib, stel, ethy	$(Ca,Mg)_3(AsO_4)_2.$ $6H_2O$	G. 2.6. BB in closed tube yields water and becomes opaque. BB in OF fus with intumescence to enamel and colors fl light blue (As); ignited mineral alkaline to test paper. Insol in water, but readily sol in acids. *A.* Niccolite, Chloanthite, Pyrargyrite.

Name	Lustre	Color	Hardns	Tenacity
Coquimbite (White Copperas)	vitreous	wh, yel, brn, grn, violet	2.25	brittle
Senarmontite	adm, res	white, gray	2.25	brit to sect
Mascagnite	vitreous	yel, gry, lemon-yel	2.25	.....
Claudetite	pearly, vitreous	white to clss	2.5	flexible
Chalcanthite (Blue Stone, Blue Vitriol, Kupfer-vitriol)	vitreous	blue	2.5	brit to sect
Vivianite (Blaueisenerz)	vitr, prly, dull	blue, green, white	2.5	sectile
Biotite (Magnesia-glimmer)	pearly on base	blk, brn, dark grn	2.5	brit to sect
Ripidolite (Klinochlor)	pearly on base	grn, when containing Cr, blue	2.5	sectile
Halite (Common Salt, Steinsalz)	vitr to res	wh, gry, seld blue or red	2.5	brit to sect
Gay-Lussite	vitreous	white, yelh	2.5	very brit

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Hex *H.* rhdl	110, imperf	$(FeAl)_2(SO_4)_3.9H_2O$	G. 2.092. Astringent.
Ism *H.* octahedral *S.* massive	*Clv.* 111, dist *Fr.* gran, comp	Sb_2O_3	G. 5.2. Melts in can fl. BB in closed tube fus and partially sub. On coal gives wh ctg, which, in R F, colors outer fl grnh-blue. *A.* Valentinite, Kermesite native Antimony.
Orm	*Clv.* basal	$(NH_4)_2SO_4$	G. 1.76. Trsl. Pungent taste.
Mcl	*Clv.* 010, perf	As_2O_3	G. ± 4.
Trcl *H.* tab, scaly *S.* incr, rnd, ctg	*Fr.* comp, stky	$CuSO_4.5H_2O$	G. 2.2. Xls rare. Treat met, astring. Sol in water. Moistened and rubbed on knife-blade coats it with Cu. BB yields water and SO_2. With soda on coal, met Cu. *A.* Melanterite, Pyrite, Chalcopyrite.
Mcl *H.* ac, scaly *S.* masv, insp	*Clv.* 010, perf *Fr.* fib, ethy	$Fe_3(PO_4)_2.8H_2O$	G. ± 2.5. (See II. 6.)
Mcl *H.* fol, scy, tab, short clm *S.* masv, insp	*Clv.* bas, hly emin *Fr.* shly, scy	$(Mg,Fe)_2(K,H)_2(Al,Fe)_2(SiO_4)_3$	G. 2.9. Xls seem hex. Yields a little water. Whitens and fus on thin edges. With fluxes, reac for iron. *A.* Constituent of Granite, Gneiss, Mica Slate.
Mcl (?) *H.* fol, scy, tab, pyrl *S.* masv, insp, small rnfm, lam	*Clv.* bas, perf *Fr.* scy, comp, short fib	$H_8(Mg,Fe)_5Al_2Si_3O_{18}$	G. ± 2.7. Xls seem hex. Often strongly dichroic. Trsp to trsl Xls flx and smwh elastic. BB yields water. In platinum forceps fus on edges to gry-blk glass. In H_2SO_4 wholly decomp. *A.* Garnet, Diopside, Titanite, Adularia, Albite, Magnetite, Penninite, Serpentine, Chromite.
Ism *H.* cub *S.* masv, insp, lam	*Clv.* cub, perf *Fr.* gran, fib	NaCl	G. ± 2.1. Taste pure saline. Sol in water. Sol precip $AgNO_3$. BB fus, often with decrep, and colors fl deep yel. *A.* Clay, Gypsum, Anhydrite.
Mcl *H.* wedge	*Clv.* 110, perf *H.* cnch	$(Na_2,Ca)(CO_3)_{2\cdot5}H_2O$	G. 1.94.

Name	Lustre	Color	Hardns	Tenacity
Sylvite (Sylvin)	vitr to res	white, gray	2.5	brit to sect
Tachhydrite	.....	wax to honey-yel	.....	.....
Kainite	vitreous	yellow, gray	2.5	sect to brit
Thenardite				
Succinite (Amber, Bernstein)	waxy	yel, brn, rd, wh	2.5	brittle
Bieberite (Kobaltvitriol)	silky to vitreous	flesh- to rose-red	2.5	sect to brit
Amarantite (Hohmannite)				
Muscovite (Potash Mica, Kaliglimmer)	prly on base, often metalloid	gry, wh, lt yel, lt brn	2.5	sectile
Paragonite	pearly	yel, gry, grn	2.5	.....
Valentinite (Weissspiessglaserz)	adm, prly on base	wh, gry, lt yel, lt brn	2.5	sectile
Hydrozincite (Zinkblüthe) (See before)	dull	white	2.5	sect to brit

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* cub, cub-octl *S.* massive	*Clv.* cub, dist *Fr.* granular	KCl	G. 2. Sol in water. Pungent taste. BB melts on wire, coloring fl vilt. *A.* Carnallite, Halite, Kainite.
Hex *H.* rhdl	.....	$CaMg_2Cl_6.12H_2O$	G. Very deliquescent.
Mcl *H.* tabular *S.* massive	*Clv.* 010, dist; 110 less so *Fr.* fn-gr	$KCl.MgSO_4.3H_2O$	G. 2.1. Sol in water. Taste pungent. BB melts in fl. *A.* Carnallite, Sylvite, Halite.
Amorphous *S.* masv, lam	*Fr.* masv, cnch	$C_{40}H_{64}O_4$	G. ± 1. Electric by friction. Melts in can fl and burns with lum fl and pleasant odor. With H_2SO_4 brn sol. *A.* In loose masses, also in clays and marls sometimes.
Mcl *S.* efflorescence	*Fr.* crumbly	$CoSO_4.7H_2O$	G. 1.9. Taste astring. Sol in water. Yields water and SO_2 in closed tube. Blue, borax glass bead. *A.* Product of decomp of cobaltiferous minerals.
Mcl *H.* fol, scy, tab, pyrl *S.* masv, insp	*Clv.* bas, perf *Fr.* shly, scy, comp	$(K,Na)H_2Al_3(SiO_4)_3$	G. 3. Xls seem hex. In closed tube gives water. BB whitens and fus on thin edges to gry or yel glass. *A.* Principal constituent of Mica-schist, Gneiss, and Granite. Does not occur with Augite nor with Labradorite.
? *S.* masv	*Clv.* bas, perf	$H_2NaAl_3(SiO_4)_3$	G. 2.74.
Orm *H.* scy, ac, spln *S.* massive	*Clv.* 110, perf *Fr.* short stel	Sb_2O_3	G. 5.5. Melts in can fl. In closed tube fus and partially subl. BB *ch.* fus easily and gives wh coat, which imparts to R F green-blue color. *A.* Antimonite, Kermesite, Galenite, Blende.
(?) *S.* masv, rnfm	*Fr.* cnch, shly, gran, comp, ethy	$Zn(OH)_2(ZnOH)_2CO_3$	G. ± 3.6. Sol with effervesc. In closed tube yields water. BB yields CO_2, is yel while hot. Coats coal near assay, which, with soda, yields Zn vapors. Moistened with Co sol turns grn. *A.* Calamine, Smithsonite.

Name	Lustre	Color	Hardns	Tenacity
Remingtonite	earthy	rose	soft	earthy
Carnotite	earthy	yellow	soft	earthy
Deweylite (Gymnit)	resinous	yellow	2.5	brittle
Lepidolite (Lithionglimmer, Lithionit)	base prly, partly submet	vilt, lt red, dk grn, gry	2.5	sectile
Phlogopite	base prly	brown, red, yellow	2.5	sect to brit
Matlockite	adm, prly	yellow to grnh	±2.75	.....
Zinnwaldite	pearly	pale violet, yel to brn	2.75	lam tough, flx

2

Sussexite	silky to prly	wh, tinge of pink	3	....
Lepidomelane	adm, vitr, prly	black	3	smwh brit
Carnallite	vitreous	red, white	3	brittle
Glauberite	vitr to res	wh, gry, lt yel	3	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Incr	.....	Hydrous Cobalt Carbonate	G. Radioactive.
Incr, ethy	.....	$K_2U_4V_2O_{12}.3H_2O$	G.
Amorphous *S.* massive	*Fr.* compact	$Mg_4H_4Si_3O_{12}$	G. 2.2. Closed tube gives much water. BB fus on edges and becomes opaque. Decomp by HCl. *A.* Serpentine, Magnesite.
Mcl *H.* fol, scy *S.* massive	*Clv.* bas, hly emin *Fr.* scy, gran	$Al_2(Li,K,Na)_2(OH,F)_2Si_3O_9$	G. ± 2.9. Xls seem hex. Melts in can fl. Yields water. BB fus with intumesc and colors fl lithium-red. *A.* Tourmaline bearing granites, and with tin ore.
Mcl *H.* fol, scy, tab *S.* insp	*Clv.* bas, hly emin	$(Al,Fe)(Mg,Fe)_3(K,Na,H,F)_2Si_3O_{12}$	G. 2.9. Xls seem hex. Yields water which often tests for F. BB whitens and fuses on edges. Decomp by H_2SO_4. *A.* Especially characteristic of serpentine and xln limestone and dolomite.
Ttrg *H.* tab	*Clv.* bas, imp *Fr.* unvn	Pb_3Cl_2O	G. 7.21. Trsp to trsl.
Mcl *H.* tab, lam	*Clv.* bas, perf *Fr.* scaly	$(F,OH)_2(Li,K,Na)_3Al_3FeSi_5O_{16}$	G. ± 3.

Sectile

Orm (?) *H.* fibrous	.....	$[(Mn,Mg,Zn).OH]BO_2$	G. 3.42. Trsl.
.....	*Clv.* bas emin	H,K,Fe,Al,Si,O	G. 3.1.
Orm *H.* pyramidal *S.* massive	*Fr.* coarsely gran, comp	$MgCl_2.KCl.6H_2O$	G. 1.6. Xls rare. Deliques. Taste pungt. Melts in can fl. BB fus easily. Sol in water. Strongly phosphoresc. *A.* Sylvite, Kieserite, Halite.
Mcl *H.* tab, clm *S.* massive	*Clv.* bas perf *Fr.* thin shly	$Na_2Ca(SO_4)_2$	G. ± 2.7. Taste bit. Partially sol in water. Melts in can fl. BB decrep, turns wh, and fus, coloring fl yel. With soda gives hepar reac. *A.* Halite, clay.

Name	Lustre	Color	Hardns	Tenacity
Mellite (Honigstein)	greasy	yel, brn, wh	3	brittle
Phosgenite (Bleihornerz)	adm to res	gray-wh, pl yel, pl grn	3	brittle
Gibbsite	vitr, bas prly	wh, tinged rd, grn, yel	3	tough
Mendipite (Chlorspath, Berzelite)	adm, prly on clv planes	yelh-wh to pale yel	3	brittle
Caledonite (Allied to Leadhillite)	resinous	vrdg- & mountain-green	3	brittle
Arsenolite (Arsenolith)	adamantine	white	3	sectile
Wulfenite (Gelbbleierz)	adm, vitr, res	yel, wh, gry, rd	3	brittle to sectile
Stolzite (Scheelbleierz)	resinous	gray, brown	3	sectile
Calcite (Calc Spar, Iceland Spar)	vitreous, dull	all colors, gen wh	3	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ttrg *H.* pyramidal	*Clv.* 111, dist	$Al_2C_{12}O_{12}.18H_2O$	G. ± 1.5. Whitens in can fl but does not take fire. Yields water. Decomp by boiling water. Sol in HNO_3. *A.* Lignite.
Ttrg *H.* clm, pyrl, cuboid	*Clv.* 110 and 100, perf; bas, dist	$(PbCl)_2CO_3$	G. ± 6.2. Melts in can fl. Effervesc with acids. BB melts easily to yel globule, which, on cooling, becomes wh and xln. *Ch.* in R F met Pb and wh coat of $PbCl_2$. Bead of mcrc with Cu gives reac for Cl. *A.* Cerussite, Galenite.
Mcl *H.* hex	*Clv.* bas, emin	$AlPO_4(H_2O)_4$	G. 2.35. Argil odor.
Orm *H.* clm, *S.* rdl	*Clv.* 110, perf	$Pb_3O_2Cl_2$	G. ± 7.1. Decrep and becomes more yel. BB fus easily to lead but, and with mcrc bead and Cu shows Cl. *A.* Earthy Manganese Oxide, clay.
Mcl *H.* clm, *S.* masv	*Clv.* bas, also 100 *Fr.* uneven	$(Pb,Cu)_2SO_4CO_3$	G. ± 6.4. Partly sol in HCl with effervesc. With soda, in R F, but of Pb. *A.* Lead ores, Linarite.
Ism *H.* octl, cap *S.* bot, stal, ethy	.....	As_2O_3	G. ± 3.7. Subl in tube, condensing on walls in minute octahedrons. BB *ch.* vol, giving As odor and wh fumes. An isomeric mineral, Claudetite, xlizes mcl. *A.* Ores of silver, lead, arsenical iron, etc.
Ttrg *H.* tab, cuboid, pyrl *S.* massive	*Clv.* 111, very smooth; 001 dist *Fr.* granular	$PbMoO_4$	G. ± 6.5. Closed tube decrep and fus. BB, with borax, clss glass, which, in R F, becomes dirty grn. *Ch.*, with soda, met Pb. *A.* Calcite, Galenite.
Ttrg *H.* pyrl, cuboid, short tab	*Clv.* bas, imperf	$PbWO_4$	G. ± 8. BB decrep and fus to a xln, lustr, and met pearl. With mcrc in O F clss glass, which, in R F, becomes blue on cooling. Decomp by HNO_3, leaving yel residue of H_2WO_4. *A.* Lepidolite, smoky Quartz.
Hex *H.* rhdl, clm, ac, tab, sclh *S.* masv, insp, rnd, lam	*Clv.* R, 105°, hly perf *Fr.* gran, comp, stky, fib, ethy	$CaCO_3$	G. ± 2.6. BB infus. Strongly luminous. Sol in acids with effervesc. *A.* In ore veins, limestone, geodes, etc., very widely distributed.

Name	Lustre	Color	Hardns	Tenacity
Vanadinite (Vanadinspath, Vanadinbleispath)	resinous	yellow, brown	3	brittle
Anhydrite (Karstenit)	vitr, 010 prly, res	wh, pl rd, pl blu, gry	3	brittle
Celestite (Cölestin)	vitr, base smwh prly	white, blue	3	brittle
Barite (Heavy Spar, Barytes, Schwerspath)	vitr, base smwh prly, res, silky	all colors, principally rd and yel	3	brittle
Anglesite (Vitriolbleierz)	adm, res	white	3	brittle
Beauxite (Bauxite)	dull, earthy	whsh, gryh to ochre-yel, brn, and red	3 (?)	sectile
Polyhalite	vitr, res, silky	red, gray	3	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Hex *H.* ac, short clm *S.* small rnfm	*Fr.* fine stalky, fibrous	$Pb_5Cl(VO_4)_3$	G. ± 6.9. In closed tube decrep and yields faint white subl. BB *ch.* fus to blk mass, which, in RF, gives met bead. After oxidizing all the lead the blk residue gives, with merc in R F, grn bead, which becomes yel in O F. *A.* Calcite, Galenite.
Orm *H.* tab, cuboid, spln, short clm *S.* masv, lam	*Clv.* 010 perfect 100 } dist 001 } *Fr.* gran, stalky, comp, spln	$CaSO_4$	G. 2.9. Xls rare. Sol in HCl. BB fus, coloring fl rdsh yel, and yielding bead which reacts alkaline. *A.* Clay, Calcite, Gypsum, Halite.
Orm *H.* tab, clm, ac *S.* masv, lam, nod	*Clv.* bas, perf 110 obs 110 ∧ 110, 104° *Fr.* stalky, fib, fine gran, comp	$SrSO_4$	G. 4. BB frequently decrep and fus to wh pearl, coloring fl red, and giving off SO_2. *Ch.* fus easily to a but. Residue alkaline. With soda, hepar reac on Ag. *A.* Limestone, marl, Calcite, Gypsum, Sulphur, also in Galena veins.
Orm H. tab, clm, ac, pyrl *S.* rounded, lam, masv	*Clv.* bas perf 110 obs 110 ∧ 110, 102° *Fr.* shelly, fib, gran, compact, earthy	$BaSO_4$	G. 4.3–4.7. BB decrep and fus, coloring fl yelh-grn and giving off SO_2. With soda, hepar reac on Ag. *A.* Fluorite, Galenite, Argentite, Pyrargyrite, Proustite, Niccolite, Chloanthite, Chalcopyrite, Pyrolusite, Psilomelane, Hematite, Limonite. Frequent in gangues of silver and lead ores.
Orm *H.* tab, clm, ac, pyrl *S.* massive	*Clv.* bas, perf 110 obs 110 ∧ 110, 104° *Fr.* compact	$PbSO_4$	G. ± 6.2. Xls rare. Decrep. Fus in can fl. BB *ch.*, in O F, clear bead, which becomes milk-white on cooling. R F reduced with effervesc to met Pb. With soda, hepar reac. *A.* Cerussite, Galenite.
S. in round dissem grains, masv, oolitic, ethy	*Fr.* carthy	$Al_2O(OH)_4$	G. 2.5. In matrass yields water. With cobalt sol, blue. *A.* Limestone.
Usually comp, fib *H.* splintery *S.* massive	*Fr.* stalky, fib	$Ca_2Mg,K_2(SO_4)_4.2H_2O$	G. 2.7. Xls rare. Melts in can fl. Yields water. BB fus and colors fl yel. *Ch.* fus to rdsh bead, which in R F becomes wh. Partially sol in water, leaving $CaSO_4$, which dissolves in large excess of water. *A.* Halite.

Name	Lustre	Color	Hardns	Tenacity
Kieserite (Kieserit)	glinting	wh, gry, lt yel	3	brittle
Ganomalite	vitr to prly	colorless, gray	3	very brit
Cryolite (Kryolith)	vitreous, pearly	white, gray	3	brittle
Allophane (Riemannit)	vitreous	wh, blu, yel, grn, brn	3	brittle
Pachnolite (Pyrosonite)	vitreous	cls to white	3	brittle
Wavellite (Hydrargyrite, Striegisan)	vitreous, silky	all colors, principally yel, grn, and wh	3	brittle
Hanksite	vitreous	white	3.25	brittle
Stilpnomelane (Chalcodite)	prly, vitr, sub met	grnh-brnz, blk	3.4	smwh brit
Thaumasite	unct, dull	white	3.5	brittle
Hardystonite	vitreous	white	3.5	brittle
Adamite	vitr to adm	honey-yel; externally, often violet streak, white	3.5	sectile

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Mcl *H.* pyramidal *S.* massive	*Clv.* 111 dist *Fr.* gran, comp	$MgSO_4.H_2O$	G. 2.5. Weathers easily. Absorbs water. Xls rare. Sol in water. Fus easily. *A.* Carnallite, Sylvite, Halite.
Ttrg	110 and 001 dist	$Pb_2(Ca,Mn)_2Si_3O_{11}$	G. 5.74. Långban, Sweden.
Mcl *H.* short clm, cuboid *S.* massive	*Clv.* in three nearly perpendicular planes *Fr.* coarse gran, large shly	$AlF_3.3NaF$	G. ± 3. Xls rare and apparently ism. Melts in can fl. Heated in open tube so that fl enters tube, gives off HOF and etches glass. Colors fl yel, and gives blue with Co sol. *A.* Siderite, Galenite, Chalcopyrite, Zincblende.
Amorphous *S.* usually in thin incrs, mam, stal, masv	*Fr.* cnch, comp	$Al_2SiO_5.5H_2O$	G. 1.8. Yields much water in closed tube. Crumbles. Gelatinizes with HCl. BB infus. *A.* Limonite, alum slates.
Mcl *H.* prsm acute term	*Clv.* 001 *Fr.* unvn	$(Na,Ca,Al)F_6H_2O$	G. ± 2.97.
Orm *H.* acicular *S.* rnfm, hemispherical	*Clv.* dist *Fr.* rdl	$((Al.OH)_3(PO_4)_2)_2.9H_2O$	G. 2.3. Xls small and rare. Yields much water, last portions of which taste acid. BB, in forceps, swells and splits to fine ac particles, which are infus, but color fl grn. With Co sol, blue. *A.* Hematite, Limonite, Pyrolusite, quartz slates, sandstones.
Hex *H.* prsm	*Clv.* bas dist *Fr.* unvn	$(Na_2)_5CO_3(SO_4)_4$	G. 2.562. Taste saline.
? *H.* fol plates	*Clv.* in one plane	$(Fe,Mg)_4Al_2Si_5O_{15}.3H_2O$	G. 2.85.
Ttrg or Hex	*Fr.* sub cnch	$Ca_3SiCSO_{10}.15H_2O$	G. 1.877. Trsl.
Ttrg	*Clv.* 001 good	Zn,Ca,Mn,Mg,Fe,Si	G. 3.396.
Orm *H.* short clm *S.* insp, ctg	*Clv.* 100 very dist	$(ZnOH)ZnAsO_4$	G. 4.34. Easily sol in dilute HNO_3. In matrass decrep feebly and yields a little water, becoming wh and porcelanous. With soda, a ring of As. BB *ch.* ctg of ZnO and feeble odor of As. Borax, in O F, pearl-yel, but cls on cooling. *A.* Limonite, native Silver.

Name	Lustre	Color	Hardns	Tenacity
Sulphohalite	vitreous	faint grnh-yel	3.5	.....
Pyromorphite (Grünbleierz, Braunbleierz, Buntbleierz)	res to vitr or adm	grn, brn, yel, wh	3.5	brittle
Chrysocolla (One variety) (Kieselkupfererz) (See II 2, 3, 5)	dull, gltg; when lustrous, greasy	vrdg-grn to sky-blue	3.5	brittle
Descloizite (Rhombischer Vanadit)	vitreous	blk to olive-brn	3.5	sectile
Mimetite (Mimetesit, Kampylit)	res to adm	yel, brn, wh, gry	3.5	brittle
Cerussite (Weissbleierz)	adm, res, prly, silky	wh, gry, blk, brn	3.5	brittle
Laumontite (Caporcianite)	vitr, silky, 010 pearly	wh, pl yel, pl red	3.5	brittle
Chiolite	vitreous	snow-white	3.75	brittle
Mesitite	vitr to pearly	yellow to gray	3.75	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Ism *H.* dodl	.....	$3Na_2SO_4.2NaCl$	G. 2.489.
Hex *H.* long and short clm, ac *S.* rnfm, bot, masv, incr	*Fr.* comp, short rdl	$Pb_5Cl(PO_4)_3$	G. 6.5–7.1. In closed tube, white subl ($PbCl_2$). Fus easily, coloring fl bluh-grn. BB *ch.* fus, and, on cooling, assumes polyhedral forms. Sol in HNO_3. Cl reac with mcrc and CuO. *A.* Cerussite, Galenite Barite.
Amorphous *S.* fn rnfm, bot, masv, insp	*Fr.* masv, cnch in part	$CuSiO_3.2H_2O$	G. ± 2.2. BB infus. In closed tube blkens and yields water. With fluxes, reac for Cu. Gelatinizes with acids. *A.* Malachite, Cuprite Chalcopyrite Limonite.
Orm *S.* in clusters	.....	$(Pb,Zn)(Pb,OH)VO_4$	G. 5.8. In matrass gives water. BB fus and is partially reduced to but of met Pb in a thick scoria. With borax in R F grn glass, and with nitre in O F vilt color, due to Mn. Mcrc, Cr-grn glass, orange-yel in O F. Dissolves in cold dilute HNO_3. *A.* Green Pyromorphite.
Hex *H.* short and long clm, ac, thick tab, pyrl	*Clv.* $10\bar{1}1$ dist	$Pb_5Cl(AsO_4)_3$	G. ± 7.1. Closed tube, wh subl ($PbCl_2$). BB fus to but. In R F, As odor, and reduced to metallic lead. Reacts for Cl with bead of mcrc satur with CuO by coloring fl az blue. *A.* Limonite Psilomelane.
Orm *H.* clm, ac, tab, pyrl *S.* masv, incr	*Clv.* 110 perf 010 dist 100 dist *Fr.* fn gran, ethy, comp	$PbCO_3$	G. 6.4. Smts xls seem hex. Often twins, and closed tube decrep and turns yel. BB fus very easily, and in R F yields met Pb. Sol with effervesc in HNO_3. *A.* Pyromorphite, Galenite Malachite Limonite.
Mcl *H.* clm, ac *S.* masv	*Clv.* 110 dist *Fr.* stky	$Al_2(OH)_4Ca(Si_2O_5)_2.2H_2O$	G. 2.3. Weathers easily. Gelatinizes with HCl. BB fus easily and swells up to wh enamel. *A.* Stilbite Calcite.
Ttrg *H.* pyrl	*Clv.* bas (?)	$Na_5Al_3F_{14}$	G. ± 2.87. Trsp to trsl.
Hex *H.* rhdl	*Clv.* R perf	$Mg_2Fe(CO_3)_3$	G. 3.35.

Name	Lustre	Color	Hardns	Tenacity
Picrolite (Serpentine, Chrysotile, Ophite)	feebly lustrous to ethy; *chrysotile* silky	dk grn, less frequently yel, red, brown	4	brittle to sectile
Stilbite (Desmin)	vitreous, silky, 010 pearly	wh, less frequently yel, brn, and red	4	brittle
Heulandite (Stilbite)	vitreous, 010 pearly	wh, red, less frequently yel, brn	4	brittle
Scorodite (Arseniksinter, Eisensinter)	vitreous	green, brown	4	brittle
Alunite (Alaunspath)	vitreous, bas pearly	wh, gry, lt yel, lt red, brn	4	brittle
Strontianite	vitreous, resinous	wh, gry, pl yel, pl grn	4	brittle
Witherite	vitr to res	wh, gry, pl yel	4	brittle
Aragonite	vitr, silky, res	wh, gry, pl yel, less gen grn, blue, red, vilt	4	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *S.* masv, incr	*Fr.* comp, cnch, spln	$H_4(Mg,Fe,)_2Si_2O_9$	G. ± 2.6. Yields water; fus on edges with difficulty. Decomp by HCl and H_2SO_4. Chrysotile leaves SiO_2 in fine fibres.
Mcl *H.* broad clm, spln *S.* masv	*Clv.* in one dir	$(Ca,Na_2K_2)Al_2Si_6O_{16}.6H_2O$	G. 2.1. Xls simulate orm. Attacked by acids without gelatinizing. BB exfol and curves into vermicular forms, and fus to a white enamel. *A.* Heulandite, Chabasite, Laumontite, Calcite.
Mcl *H.* tab, scy, short clm *S.* masv, insp	*Clv.* emin in one dir *Fr.* thin shelly	$H_4Al_2(Ca,Sr)(SiO_3)_6.3H_2O$	G. ± 2.2. Decomp by HCl without gelatinizing. BB curls up, exfol, and fus to wh enamel. *A.* Stilbite, Calcite.
Orm *H.* pyrl, short clm, short ac *S.* masv, fnly rnfm	*Clv.* 010 dist *Fr.* stky, fn-gran, comp	$FeAsO_4.2H_2O$	G. ± 3.2. In closed tube yields neutral water and turns yel. BB fus easily, coloring fl blue, leaving magn scoria. *A.* Pharmacosiderite, Limonite, Arsenopyrite, Pyrite.
Hex *H.* rhdl, tab, like octahedral, like cube *S.* masv, nod	*Clv.* bas, perf *Fr.* gran, masv, ethy	$(AlO)_2K(SO_4)_2.3H_2O$	G. ± 2.6. Xls very small. Decrep and is infus. Yields water, sometimes $(NH_4)_2SO_4$. With Co sol yields fine blue color. With soda, hepar reac. *A.* On Trachyte. Nodular. In sand.
Orm *H.* ac, dart-like, acute pyr *S.* massive	*Clv.* 110 dist 010 dist *Fr.* fib, thin stky	$(Sr,Ca)CO_3$	G. ± 3.7. BB swells up. Throws out minute sparks, fus only on thin edges, and colors fl Sr-red. Effervesc with acids. H_2SO_4 produces precip in dilute sol. *A.* Silver, Lead, and Copper veins; also in deposits by itself.
Orm *H.* pyrl, tab, clm *S.* masv, rnfm	*Clv.* 110 dist 010 } less so 100 } *Fr.* radial	$BaCO_3$	G. ± 4.2. Xls simulate hex. BB fuses to bead and colors fl yelh-grn. Assay tests alkaline after fusion. Dissolves in HCl with effervesc. The dilute sol precip wh with H_2SO_4. *A.* Galenite, Alstonite, Barytocalcite.
Orm *H.* ac, long & short clm, thick tab, dart-like, chisel-like *S.* masv, lam, rnfm, sphl, hackly, incr	*Clv.* 010 dist 110 } traces 011 } *Fr.* stky, fib, shly, comp	$CaCO_3$	G. 2.9. Often twinned and multiple twinned. BB falls to pieces, loses CO_2 and glows brightly. Dissolves with effervesc in acids. Moistened with HCl gives Ca color to fl. *A.* In veins of limestone, Dolomite, and basalt. In Gypsum, Limonite, and Siderite deposits.

Name	Lustre	Color	Hardns	Tenacity
Bromlite (Alstonite)	vitr, res	white	4	brittle
Barytocalcite	vitreous	white, yellowish	4	brittle
Triphylite (Triphylin)	resinous	grnh, gry, blu in spots	4	brittle
Picrolite (Variety Serpentine) (See III 2, *ante*)	feebly waxy	yel, grn, wh	4	brit to sect
Leucophanite	vitreous	wh, grn, yel, cls	4	very brit
Zinc Blende (Blende, Black Jack, Sphalerite)	adamantine	yel, red, grn, & very seld wh	4	very brittle
Bismutite (Bismutosphärit, Wismuthocher in part)	generally dull or glinting, resinous	gry, lt yel, lt grn	4	brittle
Fluorite	vitreous	all colors; blk, rd, and brn are most *uncommon*	4	brittle

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Orm *H.* acu pyrl *S.* massive	*Fr.* fib, gran	$(Ca,Ba)CO_3$	G. 3.7. Xls simulate hex. Sol in HCl with effervesc. BB fus on thin edges and colors fl yelh-grn. Alkaline after ignition. *A.* Witherite, Barytocalcite.
Mcl *H.* ac *S.* masv	*Clv.* 110 perf *Fr.* gran, stky	$(Ca,Ba)CO_3$	G. 3.6. Dissolves in dilute HCl. BB infus. Colors fl yelh-grn. Strong ignition pl grn color and afterwards alkaline reac. *A.* Alstonite, Witherite.
Orm *S.* massive	*Clv.* bas, 010 } dist 110 less so *Fr.* large gran	$Li(Fe,Mn)PO_4$	G. ± 3.6. Weathers. BB turns dk and gives off some water. Fus, coloring fl Li-rd, with pl bluh-grn at ext cone of fl. With borax, an iron bead. With soda, reac for Mn. Sol in HCl. *A.* Beryl. In granite.
Amorphous *S.* incr, masv	*Fr.* comp; in large pieces, cnch; in small, spln	$H_4(Mg,Fe)_3Si_2O_9$	G. ± 2.5. Greasy to touch. Bit odor when breathed on. Fibres not fix. Yields water. Fus on edges with difficulty. *A.* Serpentine.
Orm *H.* tab	*Clv.* bas perf *Fr.* cnch	$Na(BeF)Ca(SiO_3)_2$	G. 2.959.
Ism-tetr *H.* octl, tetr, dodl *S.* masv, insp, rnd	*Clv.* 110 perf, Bethlehem variety very slight *Fr.* gran, comp	ZnS or $(Zn,Fe,Mn,Cd)S$	G. ± 4. Open tube SO_2, and gen changes color. BB very difficult to fuse. *Ch.*, with soda, grn Zn-fl. In R F on coal a zinc coat. Bethlehem var crypto-xln. *A.* (1) Arsenopyrite, Chalcopyrite, Pyrite, Galenite, Siderite, Baryte. (2) Pyroxene, Aplome-Garnet, Magnetite, Magnetopyrite. Frequent in gangues of silver and lead ores.
Xln *S.* masv, insp, small spheroid	*Fr.* ethy, comp, crumpled, shly	$BiO.Bi(OH)_2CO_3$	G. 6.9. Sol in HCl with effervesc and deep yel sol. Melts in can fl. In matrass decrep and gives water. BB RF but of Bi and gives coal yel coat. *A.* Native Bismuth and Bismuthinite.
Ism *H.* cubic, octl *S.* masv, insp	*Clv.* 111 perf *Fr.* stky, comp, gran, ethy	CaF_2	G. ± 3.1. In closed tube decrep, loses color, and phosphoresces. BB fuses, coloring fl rd. Residue reac alkaline. With H_2SO_4, fumes etch glass. *A.* In gangues of met ores. In beds and veins. With gneiss, mica slate, clay slate, and in limestones. With a great many minerals.

Name	Lustre	Color	Hardns	Tenacity
Ankerite (Braunspath in part)	vitreous, pearly	gry, wh, yelh, brnh	4	brittle
Dolomite (Bitterspath, Braunspath in part)	vitreous, R partly pearly	wh, gry, yel, rd, brn, grn	4	brittle
Pistomesite (Breunnerite)	vitreous, R pearly	yelh-wh, yelh-gry	4	brittle
Crocidolite	silky to dull	lvndr-blu to leek-grn	4	tough, comp, elas
Siderite (Spathic Iron, Eisenspath, Spatheisen stein)	vitreous, R pearly	pea- and Isabella-yel, yelh-gry, and brn	4	brittle

3

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Colemanite	vitr to adm	Cls, milk-wh, gry	4.25	Mcl *H.* short prsm
Pyrosmaltite	pearly	dark grn to brn	4.25	Hex *H.* rhdl, prsm, tab

Crystal System Habit and Structure	Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Hex *H.* obt rhdl *S.* masv	*Clv.* R, 106°, perf; faces often curved *Fr.* granular	$(Ca,Mg,Fe,Mn)CO_3$	G. 3. Sol with effervesc in HCl. BB infus. Darkens and becomes magn. *A.* Siderite, Galenite, Blende.
Hex *H.* acu or obtuse rhdl *S.* massive	*Clv.* R, 106°, perf; faces often curved *Fr.* gran, comp	$(Mg,Ca)CO_3$	G. 2.8. Sol with effervesc in warm HCl, slowly in cold HCl. BB does not fuse to clear mass with soda on platinum foil. Glows and gives off CO_2. *A.* In extensive beds. Serpentine and other magnesian rocks. With a great many minerals.
Hex *H.* obtuse rhdl *S.* massive	*Clv.* R, perfect *Fr.* coarsely gran, large gran	$(Mg,Fe)CO_3$	G. 4. Sol with effervesc in warm HCl. BB infus. *A.* Pyrite, Specularite.
? *H.* fibrous	*Clv.* prsm	$Na_2Fe_3Si_8O_{15}$	G. 3.25. Fibres smwt elas.
Hex *H.* obtuse rhdl, lent, sclh, acute rhdl *S.* masv, rnfm, wrty, nod, lam	*Clv.* R, 107°, perf; faces often curved *Fr.* gran, comp, shly, rarely fib	$FeCO_3$	G. ± 3.8. Dissolves with effervesc in warm HCl. BB decrep, evolves CO_2, blkens, and becomes magn. With fluxes reac for Fe, and, with soda and nitre on platinum foil, gen for Mn. *A.* In silver and tin gangues, also with gneiss, mica slate, and clay slate, and as clay ironstone in coal measures.

Semi-hard

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 010 highly perf	$Ca_2B_6O_{11}.5H_2O$	G. 2.417. Trsp to trsl.
Clv. bas, perf *Fr.* unvn, spln	$H_7(Fe,Mn)Cl(Fe,Mn)_4Si_4O_{16}$	G. ± 3.12. Strong double refraction.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Magnesite † (Talkspath, Bitterspath)	vitreous, dull	wh, pl yel, gry, blk	4.5	Hex *H.* obt rhdl *S.* masv rnfm
Seybertite	pearly, sub met	rdsh brn, yel, cop rd	4.5	Mcl *H.* tab
Rhodochrosite † (Rose Spar, Manganspath, Manganocalcit, Dialogit)	vitr, partly prly and res	rose-red	4.5	Hex *H.* obt and acu rhdl, acu sclh *S.* spher, rnfm, masv
Ralstonite	vitreous	clss to white	4.5	Ism *H.* Octl
Yttrocerite	glistening	vilt blu to wh	4.5	? *H.* masv
Smithsonite (Zinkspath, Galmei in part)	vitr to res	wh, pl yel, pl grn, gry, brn	4.5	Hex *H.* obt and acute rhdl, acute sclh *S.* bot, rnfm, warty, masv
Cervantite	greasy, prly, ethy	Isabel yel to rdsh wh	4.5	Orm *H.* ac
Margarite † (Perl-Glimmer, Kalkglimmer)	base pearly	wh, gry, pl grn	4.5	Mcl *H.* thin tab, scaly *S.* masv
Scheelite (Scheelspath)	res to adm	brn, yel, gry, wh	4.5	Ttrg *H.* pyrl, seld tab, lent *S.* masv, insp
Gmelinite	vitreous	clss, yel, grn, rd, wh	4.5	Hex *H.* rhdl

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. R, 107° 30′, perfect *Fr.* gran, comp, ethy	$MgCO_3$	G. 3. Effervesc with acids. BB infus, whitens, loses CO_2, and glows brightly. Residue alkaline. With Co sol on platinum foil red color. *A.* Chlorite slate, Talc slate, Serpentine.
Clv. 001 perf *Fr.* coarse gran	$H_6(Mg,Ca,Fe,Al)_{10}Si_4O_{26}$	G. ± 3.
Clv. R, 107°, perf, curved faces smts	$(Mn,Ca.Fe,Mg)CO_3$	G. ± 3.5. BB changes to gry, brn, and blk. Decrep, but is infus. With mcrc and borax, in OF, amethyst bead. RF, by continued blowing, clss. Co sol on platinum foil bluh grn. Dissolves with effervesc in warm HCl. *A.* (1) Galenite, Blende, argentif. Tetrahedrite, native Gold. (2) Limonite Hematite.
Fr. unvn	$Na,Ca,Mg,Al,F,(H_2O)$	G. ± 2.6. Trsp to trsl.
Clv. two planes *Fr.* unvn	$(Y,Ce,Er)_2Ca_5F_8(H_2O)$	G. 3.447.
Clv. R, 108°, perf, curved faces smts	$ZnCO_3$	G. ± 4.2. Xls mostly small. Sol in warm HCl with effervesc. In closed tube yields CO_2, and is yelh hot, and wh cold. BB infus. Co sol gives grn color. A. Calamine Galenite, Blende.
Fr. unvn, ethy	$SbSbO_4$	G. 4.084.
Clv. bas perf *Fr.* scaly, gran	$H_2CaAl_4Si_2O_{12}$	G. 3. Yields water in closed tube. BB whitens and fus on edges. *A.* Chlorite, Corundum, Magnetite, Rutile.
Clv. 111, 101 } perfect	$CaWO_4$	G. ± 6. Fus to semi-trsp glass, which is opaque on cooling. BB, with mcrc, a bead, clss in outer fl; in inner, grn while hot and blue when cold. Decomp by HCl, leaving yel residue, sol in amn. *A.* (1) Wolframite, Cassiterite, Fluorite, Lepidolite. (2) Galenite, Blende, Siderite. (3) Magnetite, Blende, Pyrite. (4) On and in limestone.
Clv. 110 dist *Fr.* unvn	$(Na_2,Ca)Al_2Si_4O_{12}(H_2O)_6$	G. ± 2.1. Trsp to trsl.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Triplite	resinous	brown, black	4.5	Mcl *S.* masv, insp
Prosopite	vitreous	clss, wh, grysh	4.5	Mcl (?) *H.* gran, masv
Wollastonite	vitr, 001 prly, silky	wh, gry, seld pl rd, pl yel	4.5	Mcl *H.* tab, spln *S.* masv
Chabazite (Phakolith)	vitreous	white	4.5	Hex *H.* rhdl, cuboid, obtuse pyrl, lent
Childrenite (Eosphorite)	vitr to res	yel, wh, brn, blk	4.5	Orm *H.* pyrm
Tysonite	vitr to res, prly	pale yel to rdsh brn	4.75	Hex *H.* prsm
Thorite (Orangit)	vitr, res, greasy	orng, brn yel, blk	4.75	Ttrg *H.* pyrm capped prsms
Lithiophilite (Triphylite)	vitr to res	brn, dark on surf	4.75	Orm *H.* masv
Apophyllite (Fischaugenstein, Ichthyophthalmit, Tesselite, Oxhaverite, Xylochlor, Leucocyclite)	vitreous 001 pearly	wh, pl yel, pl rd	5	Ttrg *H.* tab, clm, acute pyrl, cuboid *S.* massive
Eulytite (Kieselwismuth, Agricolit)	adamantine	brn, yel, gry, wh	5	Ism *H.* tetr, dodl, often rounded *S.* spheroidal *Agricolit* Mcl

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 010 dist bas less so	$(Fe,Mn)PO_4(Fe,Mn)F$	G. ± 3.6. BB fus easily to black magn globule. With borax in OF, amethyst bead of Mn; with soda, Fe reac; with H_2SO_4 evolves F and etches glass. *A.* Apatite, Beryl.
Clv. 010 dist	$Ca(F,OH)_2[Al(F,OH)_3]_2$	G. 2.88. Trsp to trsl.
Clv. 100 001 101 } rtr perf *Fr.* shly, stky, fibrous	$CaSiO_3$	G. ± 2.8. Rubbed or warmed becomes phosphores in the dk. In matrass no change. BB fus easily on edges. Gelatinises with HCl. *A.* Calcite Garnet Vesuvianite, Graphite, Bornite.
Clv. R distinct	$Al_2(Ca)Si_6O_{16}.8H_2O$ $Al_2(Ca)_2Si_4Al_2O_{16}8H_2O$	G. ± 2.1. Often twinned. BB intumesces and fus to blebby glass nearly opaque. Decomp by HCl with sep of gelatinous silica. *A.* Phillipsite Stilbite Heulandite Analcite Calcite.
Clv. 100 *Fr.* unvn	$Al(OH)_2(Fe, Mn, Ca)$ PO_4H_2O	G. 3.21.
Clv. bas *Fr.* sub cnch	$(Ce,La,Di)F_3$	G. 6.13. Trsp to trsl.
Clv. 111 dist *Fr.* cnch	$ThSiO_4$	G. ± 5.3. Trsp in splints to opq.
Clv. 0 perf *Fr.* unvn to sub cnch	$Li(Mn,Fe)PO_4$	G. 3.5.
Clv. 001 hly perf 110 dist *Fr.* large shly	$(Ca_4KH_7(SiO_3)_8)_2.9H_2O$	G. 2.3. In closed tube exfol, whitens, and yields water. BB exfol and colors the fl vilt. With acids, slimy silica. *A.* Analcite, Natrolite, Calcite.
Fr. radial	$Bi_4(SiO_4)_3$	G. 6. In matrass decrep and yields a little water. BB fus and froths on coal, staining it yel-brn. Fus with soda to but, at first grnh yel, then rdsh yel, and yields finally met Bi. *A.* Bismutite Hypochlorite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Berzeliite (Pyrrharsenite)	resinous	yel to yelsh red	5	Ism *H.* masv
Calamine (Kieselzinkerz, Galmei in part Hemimorphite)	vitr, prly, silky	wh, pl yel, pl blu	5	Orm *H.* tab, spln, ac, cap *S.* rnfm, incr
Enstatite (Bronzite)	010 met, prly, silky	brown, green	5	Orm *H.* clm, ac
Variscite (Callaite)	vitr brilliant	deep emld grn to clss	5	Orm *H.* prsm
Apatite	vitr res	in all colors	5	Hex. *H.* tab, clm, ac *S.* masv, rnfm, bot
Carpholite	silky	straw-yellow	5	Mcl. *H.* ac, cap *S.* masv
Pyrgom or **Fassaite** (Green Augite in part. Variety Pyroxene)	vitr, partly res	grn, gen drk grn	5	Mcl. *H.* short clm, acu pyrl *S.* masv
Haüynite	vitr to res	blue, seld wh	5	Ism *H.* dodl, oct *S.* insp, masv
Homilite	res to vitr	blk to brn	5	Mcl
Melilite	vitreous	wh, yel, brn	5	Ttrg

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Fr. sub cnch	$(Ca,Mg,Mn,Na_2)_3(AsO_4)_2$	G. 4.08.
Clv. 110 perf 101 dist	$(Zn.OH)_2SiO_3$	G. 3.16–3.9. Xls generally small. In closed tube decrep, whitens, and gives water. BB moistened with Co sol gives grn color when heated. *Ch.* with soda gives yel coat, which cools to wh. By HCl decomp and gives gelatinous silica. *A.* Smithsonite.
Clv. 010 perf 110 imperf 100 in traces *Fr.* large and coarse gran, fib	$(MgFe)SiO_3$	G. ± 3.2. BB infus, being only slightly rnd on edges. Insol in HCl. *A.* Olivine, Serpentine, basalt, meteorites, *never quarts.*
Fr. compact	$AlPO_4(H_2O)_2$	G. Trsp to trsl.
Clv. bas dist 100 dist *Fr.* fib, comp, ethy, gran	$FCa_5(PO_4)_3$ $ClCa_5(PO_4)_3$	G. ± 3.1. BB fus with difficulty on edges, coloring fl redsh yel. Moistened with H_2SO_4 colors fl bluh grn. Some var give blue fl when treated with mcrc bead saturated with CuO—(Cl), and some give F when fused with mcrc in open tube. *A.* (1) Cassiterite, Wolframite, Arsenopyrite, Fluorite. (2) Adularia, Quartz, Pistacite, Axinite, Titanite, Rutile, Specularite, Magnetite. (3) Chlorite slate, Talc slate. (4) Basalt, phonolite, diabase.
Fr. radial	$MnAl_2(OH)_4(SiO_3)_2$	G. 2.9. In closed tube gives some water, which reacts acid and attacks the glass (F). BB swells up and fuses to brn glass. With fluxes gives reac for Mn and Fe. Not decom by HCl. *A.* Fluorite.
Clv. 110 dist 110 ∧ 110, 87° *Fr.* gran, comp	$MgCa(SiO_3)_2$	G. ± 3.3. Includes green pyroxene found in metamorphic rocks. Gen unacted on by acids. *A.* Calcite, Spinel. *Not Quartz.*
Clv. dodl dist *Fr.* gran, comp	$(Ca,Na_2)Na_2(AlSO_4Na)Al_2(SiO_4)_4$	G. ± 2.4. Xls extremely rare. In closed tube retains its color. BB in forceps fus to a wh glass. With soda, *ch.*, gives hepar reac with Ag. Decomp by HCl, with sep of gelatinous silica. *A.* In trachyte, basalt, phonolite, lava. *Not with Quarts.*
Fr. sub cnch	$(Ca,Fe)_3B_2Si_2O_{10}$	G. 3.38.
Clv. 001	K,Na,Mg,Ca,Fe,Al,Si,O	G. ± 3. Trsl, trsp, opaque.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Datolite (Humboldtite, Botryolit)	vitr to res	white	5	Mcl *H.* short clm, thick tab *S.* masv, small rnfm
Harmotome (Kreuzstein, Morvenit)	vitreous	wh, pl yel, pl brn	5	Mcl *H.* broad clm, thick tab
Phillipsite (Kalkharmotom, Christianit)	vitreous	white	5	Mcl *H.* short acicular
Natrolite (Mesotype, Nadelzeolith)	vitr prsm pearly and silky	wh, pl yel, pl rd, ochre-yel, brick red	5	Mcl and Orm. *H.* ac, clm, cap *S.* rnfm, incr masv
Opal	vitreous, waxy	in all colors, most frequently wh, yel, rd, brn	5	Am *S.* masv, insp, lam, brec, incr rnd
Mesolite	vitr, silky	wh, clss, grysh, yelsh	5	Orm or Mcl *H.* prsm
Cerite (Ochroit, Cererit, Lanthanocerit)	resinous	rdsh gry, brnsh gry	5	Orm *H.* short clm *S.* massive
Hedenbergite (Iron-lime Pyroxene)	vitreous	leek-, olive-, dk green	5	Mcl *S.* massive
Pectolite	silky, sub vitr	white, gray	5	Mcl *H.* ac
Wagnerite ‡	resinous	yellow, white	5	Mcl *H.* short clm *S.* masv

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 001 dist *Fr.* gran, fn, fib	$Ca(B.OH)SiO_4$	G. 2.9. In closed tube yields much water. BB fus with intumescence to clear glass, coloring fl bright grn. Gelatinizes with HCl. *A.* Prehnite, Calcite, Magnetite.
Clv. 010 dist 001 less dist	$Al_2(Ba,Ca_2,Na_2,K_2)Si_5O_{16}.6H_2O$ $Al_2Ba,Ca_2,Na_2,K_2)_2Si_4Al_2O_{16}.6H_2O$	G. 2.4. Xls seem orm or ttrg. Often in double twins. BB whitens and then crumbles, and fuses, without intumescence, to wh transl glass. Smts phosphoresc when heated. Gelatinizes with HCl. *A.* Calcite, Galenite.
Clv. 010, 001 dist	$Al_2(Ca,Na_2,K_2)Si_5O_{16}.6H_2O$ $Al_2(Ca,Na_2,K_2)Si_4Al_2O_{16}.6H_2O$	G. 2.2. BB, same as preceding. *A.* Analcite, Chabazite.
Clv. 110 perf 110 ∧ 110, 91¼° *Fr.* rdl, comp, ethy	$(AlO)Na_2H_2O$ $Al(SiO_3)_3$ or $Al_2(SiO_4)_3Na_2H_4$	G. ± 2.2. Dimorphic. Xls often seem ttrg. Melts in candle flame. BB fuses quietly to a colorless glass. Gelatinizes with acids. *A.* Chabazite, Apophyllite Calcite.
Fr. cnch, comp	$(H_2O)_xSiO_2$	G. ± 2. BB yields water. Infus, but becomes opaque. Some yel var turn red. *A.* In fractures of many rocks.
.....	Na,Ca,Al,H,Si,O	G. 2.3. Dimorph. Trsp. to trsl.
Fr. fn, gr, spln	$(Ce,La,Di,Al)_2(OH)_3CeO(Ca,Fe)(SiO_3)_3$	G. 4.9. Xls extremely rare. Gelatinizes in HCl. BB infus, but becomes dirty yel. With borax in OF very dark yel glass when hot, becoming light yel on cooling and clss in RF. In mcrc, silica. *A.* Actinolite, Orthite, Chalcopyrite.
Clv. 110 dist 110 ∧ 110 87° *Fr.* broad stky, fib	$FeCa(SiO_3)_2$	G. 3.5. Weathering. BB fus easily to bead. *A.* Magnetite, Chalcopyrite, Blende, Pyrite.
Clv. 001, 100 perf *Fr.* unvn	$Na_2Ca_2(SiO_3)_3$	G. 2.73. Often luminous on breaking.
.....	$Mg(MgF)PO_4$	G. 3. BB fus in forceps to grnh-gry glass. Moistened with H_2SO_4 colors fl bluh grn. With borax, iron reac; with soda, effervesc, but not entirely dissolved. With H_2SO_4 gives off HF. Sol in HCl. *A.* Lazulite, Magnesite, Siderite, Barite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Monticellite	vitr res	clss, wh, yel, grn, gry	5.25	Orm *H.* rnd Xls
Scolecite (Mesotyp)	vitr, silky	wh, light yel, red	5.25	Mcl *H.* thin prsm
Monazite	resinous	red brown	5.25	Mcl *H.* sml flat prsms
Eudialyte	vitreous	rose, blu, brn	5.25	Hex. *H.* tab rndl
Meliphanite	vitreous	sulph to lem yel	5.25	Ttrg
Anthophyllite	vitr to prly	brn, gry, emld grn	5.3	Orm *H.* clm

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Lawsonite	vitr to unct	clss, pale blue	5.5	Orm
Amblygonite ‡ (Montebrasit)	vitr, res, prly	wh, gry, pl grn, yelsh grn	5.5	Trcl *S.* massive
Cancrinite	sub vitr	wh, all colors	5.5	Hex *H.* masv rarely prsm
Lazulite † (Blauspath)	vitreous	blue	5.5	Mcl *H.* pyrl, tab clm *S.* masv, insp
Willemite	vitr to res	wh, gry, pl yel, pl grn, brn, red	5.5	Hex *H.* rndl, ttar, ac, clm *S.* massive.
Thomsonite (Comptonit)	vitr, partly prly	white	5.5	Orm *H.* cuboid, short ac *S.* masv, rnd

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 010 dist *Fr.* sub cnch	$Ca(Mg,Fe)SiO_4$	G. 3.15.
Clv. 110 *Fr.* ethy, radial	$Ca(AlOH)_2(SiO_3)_3$ $(H_2O)_2$	G. 2.3. Pyroelectric.
Clv. 001 smts perf	$(Ce,La,Di)PO_4$	G. ± 5.
Clv. 001 perf *Fr.* sub cnch	$(K,Na,H)_{13}(Ca,Fe)$ $(Zr,Si)_{20}O_{52}$	G. ± 2.92. Trsl to subtrsl.
Clv. 001	$(K,Na)Ca_2Be_2FSi_3O_{10}$	G. 3. Trsp to trsl.
Clv. prsm *Fr.* sub cnch	$MgFe.SiO_3$	G. 3.15.

Hard

.....	$H_4Ca_2Al_2Si_2O_{10}$	G. 3.09.
Clv. nearly perf in three dir *Fr.* large gran, comp	$(AlF)LiPO_4$ $(Al.OH)LiPO_4$	G. ± 3.1. In closed tube yields water, which finally, at high heat, becomes acid and corrodes glass. Fus easily with intumesc, and cools into opaque wh. Colors fl yel-rd; with Co sol deep blue. In fine powder dissolves in H_2SO_4. *A.* Lepidolite, Tourmaline Topaz. In granite.
Clv. prsm perf	$(Na_2,Ca)_4H_6(NaCO_3)_2Al_6$ Si_9O_{36}	G. ± 2.45. Trsp to trsl.
Fr. gran, comp	$(Al.OH)_2(Mg,Fe,Ca)$ $(PO_4)_2$	G. 3. In closed tube whitens and yields water. Co sol the blue color is restored. BB in forceps whitens, swells, and falls to pieces without fus, coloring fl bluh grn. Unacted on by acids, retaining blue color. *A.* On Quartz veins.
Clv. $11\bar{2}0$ (N.J.) 0001 (Moresnet) both easy *Fr.* fine granular	Zn_2SiO_4	G. ± 4. Gelatinizes with HCl. BB glows and fus with difficulty to wh enamel. *Ch.* powder with soda gives yel ctg while hot and wh on cooling. *A.* Smithsonite, Calamine, Zincite, Franklinite.
Clv. 010 dist 100 less so	$(Al_2(Ca,Na_2)(SiO_4)_2)_2.$ $5H_2O$	G. ± 2.3. Gelatinizes with HCl. BB fus with intumesc to wh enamel, losing 13.3 p. c. of water. *A.* Natrolite, Stilbite, Calcite, Elæolite. In cavities in igneous and metamorphic rocks.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Analcite (Analcim)	vitreous	white, pale red	5.5	Ism *H.* ikst, cub *S.* massive
Nosite (Nosean)	vitr to res	gry, brn, wh, blk	5.5	Ism *H.* dodl *S.* insp, masv
Sodalite	greasy to vitr	blue, gry, grn, wh	5.5	Ism *H.* dodl *S.* masv, insp
Perofskite (Perowskite)	res adm sub met	blk, brn, red, yel	5.5	Ism *H.* cuboid *S.* insp, small rnfm
Zirkelite	resinous	black	5.5	Ism *H.* Octl
Brookite (Arkansite)	adm sub met	red, brn, blk	5.5	Orm *H.* thin tab, pyrl
Andesite (Andesine, Feldspar group)	sub vitr inclining to prly	wh, gry, grnsh yelsh flesh-red	5.5	Trcl *S.* gran, masv
Gehlenite	greasy	green, brown	5.5	Ttrg. *H.* cuboid, thick tab, short clm *S.* interspersed
Andalusite (Chiastolite, Hohlspath)	feebly lustrous to ethy	gry, wh, pl yel, pl brn	5.5	Orm *H.* ac, clm
Cyanite (Disthene, Rhäticit)	vitr, partly prly	blue, less frequently wh, pl yel, pl rd, gry, blk	±5.5	Trcl *H.* clm, spln, ac, thick scy, flat gran *S.* massive

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Fr. granular	$Al.Na(SiO_3)_2.H_2O$	G. 2.2 Gelatinizes with HCl. Yields water. BB fus to clss glass. *A.* Apophyllite, Natrolite, Phillipsite.
Clv. 110 perf *Fr.* granular	$Al_3Na_5(Al,NaSO_4)(SiO_4)_4$	G. ± 2.3. Gelatinizes with HCl, and emits H_2S odor. BB in forceps fus to wh glass. With soda no coal, hepar reac with Ag. *A.* In trachyte, phonolite, basalt, lava. *Not with Quartz.*
Clv. 110 perf *Fr.* gran, comp	$Al_3(Al.Cl)Na_5(SiO_4)_4$	G. ± 2.1. Gelatinizes with HCl and HNO_3. In closed tube blue var become wh and opaque. Fus with intumesc to clss glass. *A.* Elæolite, Zircon, Titanite. *Not with Quartz.*
Clv. cubic, distinct	$CaTiO_3$	G. 4. BB in forceps and on coal infus. Mcrc grnh bead hot, in OF, clss on cooling. RF changes to gry grn, and assumes vilt tint on cooling. *A.* Chlorite.
Fr. conchoid	Ca,Mg,Fe,U,Y,Ce,Th, Ti, Zr, O	G. ± 4.723.
Clv. 110 dist 110 ∧ 110, 100°	TiO_2	G. ± 4.2. BB infus. With mcrc, clss bead, which, in RF, assumes vilt tint on cooling. The Fe impurity obscures the violet unless treated with tin on coal. Insol in acids until fus with alkali hydrate or carbonate. Acid sol gives vilt color on introduction of tin foil. *A.* Rutile, Anatase, Titanite, Adularia, Quartz, Arkansite, Aplome-Garnet, Elæolite.
Clv. more unvn than Albite *Fr.* compact	$Al\ Na\ Si_2\ SiO_8$ $Al\ Ca\ Si_2AlO_8$	G. 2.68. BB fus in thin splinters; *Saccharite* only on thin edges. Imperf sol in acids. *A.* Many rocks, especially some trachytes.
Clv. bas distinct	$(AlO)_2(Ca_{Mg\ Fe})_2(SiO_4)_2$	G. ± 3. Gelatinizes with HCl. BB thin splinters fuse with difficulty to a gray glass; with borax, slowly to glass colored by Fe. *A.* In granular limestone.
Clv. 110 dist 110 ∧ 1$\bar{1}$0, 91°	$Al(AlO)SiO_4$	G. ± 3.2. BB infus. With Co sol, blue color. Not decomp by acids. *A.* In clay slate.
Clv. 100 perf, 010 less so (100 ∧ 010, 106°)	$(AlO)_2SiO_3$	G. 3.6. BB same as preceding. *A.* Staurolite, Almandite and Hessonite or Essonite (Garnets), Omphacite, Hornblende, Corundum.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Enstatite (Bronzit, Protobastit)	prsm pearly	pl gry, pl yel, pl grn, pl brn	5.5	Orm *H.* ac, clm
Wernerite (Scapolite, Mizzonit)	greasy, vitr, 100 pearly	gry, wh, grnsh gry, dirty grn, rdsh gry	5.5	Ttrg *H.* clm, ac *S.* massive
Ekebergite (Porzellanit, Meionit)	vitreous	white	5.5	Ttrg *H.* clm, ac
Rhodonite (Kieselmanganerz, Paisbergit, Bustamit, Fowlerite)	vitr, partly prly	raspberry- and rose-red, reddish brown and gray	5.5	Trcl *H.* short clm, short ac *S.* massive
Tephroite	adm to res	brnsh gry, rdsh gry, brnsh rd, flesh-red	5.5	Orm *S.* massive
Meionite	vitreous	clss to white	5.75	Ttrg *H.* short prsm
Babingtonite	vitr splendent	dark grnsh blk	5.75	Trcl
Béryllonite	vitr to prly	clss to wh or yel	5.75	Orm *H.* prsm to tab
Periclase	.....	clss to dark grn	6	Ism *H.* cub and octl
Titanite (Varieties and synonyms: Sphene, Séméline, Greenovite, Lederite, Spinthère, Pictite, Ligurite)	greasy, partly vitr and adm	brn, grn, yel, blk; seld wh, red	6	Mcl *H.* clm, thin tab, wedge form, chisel form, ac *S.* massive

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 110 dist 110 ∧ 110, 88°	$(Mg,Fe)SiO_3$	G. ± 3.2. Weathers. Almost infus. Only rnd on thin edges. Insol in HCl. *A.* Olivine, Apatite. In olivine rock and Serpentine.
Clv. 100, 110 dist, but interrupted *Fr.* large gran, comp, spln	$Al_2(Al\ Cl)Na_4(Si_2O_8)$ $Al_2(Al\ O)Ca_4(Si_2AlO_8)$	G. ± 2.7. Weathers. Fus easily with intumesc to white blebby glass. Decomp by HCl. *A.* Calcite, Magnetite, Augite, Hornblende brown Titanite, Epidote.
Clv. 100 dist, but interrupted	$Al_2(AlO)Ca_4(Si_2AlO_8)_2$	G. 2.7. In closed tube yields small amount of water. BB, like preceding. *A.* Sanidine, Nephelite, Augite. On limestone.
Clv. 110, $1\bar{1}0$, perf, 110 ∧ $1\bar{1}0$, 88° *Fr.* shly, gran, comp, spln	$MnSiO_3$ $(Mn,Ca)SiO_3$	G. ± 3.5. BB blkens and fus with slight intumesc. Amethyst glass with borax. *Fowlerite* gives *ch.* with soda reac for Zn. In powder partially dissolves in HCl, and insol portion becomes wh. Dkens on exposure to air. *A.* Hausmannite, Braunite, Magnetite, Franklinite, Zincite Calcite, Pyroxene, Aplome-Garnet.
Clv. perf in one dir, dist in another *Fr.* gran, comp	Mn_2SiO	G. ± 4.6. Gelatinizes without evolving Cl. BB fus at 3.5 to a black scoria. *A.* Magnetite, Franklinite Zincite Calcite.
Clv. 100 *Fr.* cnch	$Ca_4Al_6Si_6O_{25}$	G. ± 2.72. Trsp to trsl.
Clv. 110 perf *Fr.* sub cnch	$(Ca,Fe,Mn)SiO_3$	G. ± 3.36. Pleochroic.
Clv. 001 perf *Fr.* cnch	$NaBePO_4$	G. 2.845.
Clv. cub perf *Fr.* cnch	MgO	G. ± 3.694.
Clv. 110 smts *Fr.* shelly	$Ca\ Si\ Ti\ O_5$	G. ± 3.5. BB some var change color and fus with intumesc to a yel, brn, or blk glass. With borax, a clear yelsh-grn glass. Imperf sol in hot HCl. With tin in concen acid, a vilt color; with mcrc, in RF, vilt bead masked when Fe is present, if not treated with tin. *A. Sphene* imbedded in clefts of older slates. Albite, Adularia, Chlorite, Rutile. *Sémeline* in phonolite, etc. *Brown Titanite* in hornblende slate, syenite, diorite, etc., as also in Magnetite deposits.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Chloritoid (Chloritspath, Barytophyllit)	vitr, on clv planes prly	dk grn, dk grnsh gry	6	Mcl *S.* massive
Diopside (Sahlite, Malakolith Var Pyroxene)	vitreous	grn, wh, yel	6	Mcl *H.* clm, ac, spln, acute pyr *S.* massive
Leucite	vitr to resinous	gray, white	6	Ism and Ttrg(?)(dimorphic) *S.* interspersed
Tremolite (Grammatite, Calamite, Nephrite or Jade Variety Amphibole)	vitreous, silky	white, grnsh gry	6	Mcl *H.* clm, ac *S.* massive
Omphacite (Allied to Fassaite Var Pyroxene)	vitreous	grass grn leek-grn	6	Mcl *S.* massive
Arfvedsonite	vitreous	blk to deep grn	6	Mcl *H.* clm prsm
Diaspore	vitreous 010 pearly	white	6	Orm *H.* tab, broad clm *S.* massive
Turquois (Callaite, Kallait)	glinting	blue, green	6	Cryptoxlline *S.* insp, masv, incr, lam, small rnfm
Helvite (Helvin)	resinous	yellow, brown	6	Ism *H.* tetr

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. bas perf *Fr.* thin shly, scy	$Al_2(Fe,Mg)H_2SiO_7$	G. ± 3.5. In matrass yields water. BB nearly infus. Becomes darker and magn. *A.* Corundum, Almandite, Chlorite, Amphibole.
Clv. 110 perf $110 \wedge 1\bar{1}0$, 87°	$Mg\ Ca(SiO_3)_2$ $(Mg,Fe)Ca(SiO_3)_2$	G. ± 3.3. Often many facets. BB with difficulty fus. Xls sometimes divided by basal plane into a grn and a wh half. In clefts of chlorite slate, hornblende slate, and serpentine. *A.* (*Diopside*) Hessonite-Garnet, Chlorite. (*Sahlite*) Magnetite, Pyrite, Chalcopyrite Blende Galenite Calcite, Chlorite.
Clv. icositetrl	$Al\ K(SiO_3)_2$	G. ± 2.5. Xls always seem ism. BB almost infus. With Co sol gives blue color. Decomp by HCl without gelatinizing. In lava, leucitophyr, etc. *A.* Sanidine, Nephelite, Augite, Melanite-Garnet. Seldom imbedded.
Clv. 110 perf $110 \wedge 1\bar{1}0$, 124° *Fr.* stky, fib, rdl, felty	$Mg_3Ca(SiO_3)_4$	G. ± 3.2. Xls with terminal facets extremely rare. With difficulty fus. *A.* In the older limestones and dolomites.
Clv. in two dir. In one perf, in the other dist *Fr.* granular	$Mg,Ca(SiO_3)_2$	G. ± 3.2. BB easily fus. *A.* Hessonite-Garnet, Hornblende Cyanite Saussurite.
Clv. prsm perf *Fr.* unvn	$(Na_2Ca,Mg,Fe)_4(SiO_3)_4$	G. 3.45.
Clv. 010 perfect *Fr.* thin shly, broad, stky, fib, rdl	$Al\ O.OH$	G. ± 3.4. In closed tube decrep strongly, sep into prly wh scales, and finally yields water. BB infus. With Co sol, deep blue. Some var react for iron. Not attacked by acids, but after ignition sol in H_2SO_4. Trichromatic. *A.* (1) Chlorite, Magnetite. (2) In Lithomarge.
Fr. cnch to unvn, comp	$Al_2(OH_3)PO_4.H_2O$	G. ± 2.7. Sol in HCl. In closed tube decrep, yields water, and turns brn and blk. BB in forceps becomes brn and glassy, but does not fuse. Colors fl grn. With borax, in OF, yelsh-grn bead, pure grn on cooling. *A.* In Quartz slate.
Clv. 111 traces	$(Mn,Be,Fe)_7S(SiO_4)_3$	G. ± 3.2. Decomp by HCl with evolution of H_2S and sep of gelatinous silica. BB fus in RF to yelsh-brn opaque bead with intumesc. Reacts for Mn. *A.* Aplome-Garnet Galenite, Blende, Calcite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Hyalite (Var Opal)	vitreous, seldom pearly	white	6	Amorphous *S.* small bot, small rnfm stal, incr
Spodumene (Triphane, Hiddenite)	vitr 100 prly	gry, wh, grn	6	Mcl *H.* columnar *S.* massive
Acmite (Aegirite)	vitr to res	blk, grn, rdsh brn	6	Mcl *H.* tab, pyrl
Augite (Variety of Pyroxene)	vitreous	grysh and grnsh blk	6	Mcl *H.* long and short clm, ac, thick tab *S.* masv, insp
Hypersthene (Paulit)	vitr, res, 010 metalloid, prly	blksh brn, brnsh blk, 010 copper-red	6	Orm *H.* short ac *S.* insp, masv
Octahedrite (Anatase)	adm, metalloid in part	all colors, gen red, black; *not white*	6	Ttrg *H.* pyrl, thick, tab, clm
Nephelite (Nephelin, Elæolite)	vitr res	wh, gry, pl yel, brn, grn, red	6	Hex *H.* short ac, short clm thick tab *S.* masv, insp
Orthoclase (Potassium Felspar, Pegmatit, Adularia, Sanidin)	vitr, base gen prly	wh, red, gry, yel, brn	6	Mcl *H.* clm, short ac, tab, like rhdn *S.* masv, insp
Albite (Cleavelandite, Sodium Felspar, Periklin, Hyposklerit)	vitr, base pearly	gen wh or red	6	Trcl *H.* clm, rdl, comp *S.* masv, insp

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Fr. conchoidal	$SiO_2(H_2O)x$	G. ± 2. Clear as glass and clss, constituting globular concretions. BB infus. *A.* In basalt, phonolite, etc.
Clv. 100 dist 110 less so $110 \wedge 1\bar{1}0$, 87° *Fr.* broad stky, thick shly, comp	$Al(Li,Na)(SiO_3)_2$	G. 3.1. BB becomes wh and opaque; swells up, and gives rd color to fl. Fus to a clear or wh glass. Not dissolved by acids. *A.* Tourmaline. In granite.
Clv. 110 *Fr.* uneven	$NaFe(SiO_3)_2$	G. 3.5.
Clv. 110 perf, 001 and 100 dist *Fr.* comp	$Al_2O_3.Mg\ Al.SiO_3$	G. ± 3.3. BB with some difficulty fus to a bead. *A.* In basalt, basalt tufa, dolerite phonolite, andesite, melaphyre, etc. *Not with Quarts.*
Clv. 010 dist *Fr.* comp	$(Mg,Fe)SiO_3$	G. ± 3.4. Xls very rare. BB fus to a blk enamel, and *ch.* yields magn mass. *A.* Olivine, Amphibole, Magnetite, Titanite in Hypersthenite. *Not with Quarts.*
Clv. bas perf 111 dist	$Ti\ O_2$	G. ± 3.9. Sol in HCl. BB infus. With mcrc, in RF, bead, which becomes vilt on cooling. *A.* Rutile, Titanite, Albite, Adularia, Quartz, Chlorite, Fluorite.
Clv. $0\bar{1}0$ dist bas dist *Fr.* comp	$Al_8(Na_2,K_2,Ca)_4Si_9O_{34}$	G. ± 2.6. Weathers. Gelatinizes with acids. BB fus quietly to a clss glass. *A.* In nephelinite, basalt, phonolite, lava, syenite. *Not with Quarts.*
Clv. bas perf 010 dist *Fr.* gran, comp, spln	$Al(K,Na)Si_3O_8$	G. ± 2.5. Never shows multiple twin striation on base. Sometimes play of colors. BB fus with great difficulty. Var containing Na are much more fus. Not acted upon by acids. *A.* Quartz, Muscovite, in granite, gneiss, porphyry, and many rocks. *Seldom or never Pyroxene.*
Clv. bas perf 010 dist 110 less so *Fr.* gran, rdl, comp	$Al(Na,K)Si_3O_8$	G. ± 2.6. Often showing multiple twin striation on base. BB fus to a clss or wh glass imparting yel color to fl. *A.* Adularia, Quartz, Smoky quartz, Chlorite, Rutile, Titanite. Pistacite, Apatite. In diorite, granite. In clefts of gneiss and granite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Oligoclase (Calcium-Sodium Felspar. Varieties Aventurine or Sunstone, Moonstone)	res, base vitr seld prly	most frequently grn, wh, gry, red	6	Trcl *H.* clm, thick tab *S.* masv, insp
Labradorite (Sodium-calcium Felspar)	vitr to res, 001 prly	wh, gry, brn	6	Trcl *H.* clm, thick tab *S.* masv, insp
Anorthite (Calcium Felspar, Indianite)	vitreous 001 pearly	wh, gry, red	6	Trcl *H.* short ac, thick tab *S.* masv, insp
Humite	vitr to res	wh, yel, brn, plcm	6.25	Orm
Clinohumite	vitreous	wh, yel, rd, brn	6.25	Mcl
Microcline (Amazonstone)	vitr, pearly	wh to yel, red, grn	6.25	Trcl *H.* prsm, tab
Petalite	vitr to pearly	clss, wh, rdsh, grnsh	6.25	Mcl *H.* tabular
Hyalophane	vitreous	clss to wh	6.25	Mcl *H.* like Adularia, masv

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Ottrelite	.....	gry, grn	6.5	Mcl (?) Trcl (?)
Prehnite (Edelite, Jacksonite)	vitreous 001 pearly	grn, pl grn	6.5	Orm *H.* tab, short clm, short ac *S.* sphl, rnfm bot, masv

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. bas perf 010 dist *Fr.* gran, comp, spl	Al Na Si_2SiO_8 Al Ca Si_2AlO_8	G. 2.56. Gen multiple twin striation on base. BB fus at 3.5 to a clear enamel. Not affected by acids. *A.* In diabase, granite. In magnetite beds.
Clv. bas perf 010 less so *Fr.* gran, comp, spln	Al Na Si_2SiO_8 Al Ca Si_2AlO_8	G. ± 2.7. Xls rare. On 0 gen multiple twin striation and beautiful play of colors. BB fus to clss glass. Decomp with difficulty by HCl, and gen only partially. *A.* In basalt, gabbro. *Not* with Quartz nor Muscovite.
Clv. bas perf 010 perf *Fr.* gran, comp	Al Ca Si_2AlO_8	G. ± 2.76. Xls gen small and with many facets. BB fus to clss glass. From Mt. Somma decomposed by HCl with separation of silica. *A.* In gran limestone.
Fr. sub cnch, uneven	Mg(Fe,H)Si,F,O	G. 3.15.
Clv. 001 sometimes	$H_2Mg_{19}Si_8O_{34}F_4$	G. 3.15.
Clv. 001 perf *Fr.* uneven	(K,Na)Al Si_3O_8	G. ± 2.55.
Clv. 001 perf *Fr.* imp cnch	(Li,Na,H)Al$(Si_2O_5)_2$	G. ± 2.43.
Clv. 001 *Fr.* conchoidal	$(K_2Ba)Al_2(SiO_3)_4$	G. 2.805. Trsp to trsl.

Very Hard

Clv. bas	$H_2(Fe,Mn)Al_2Si_2O_9$	G. 3.3.
Clv. bas perf 110 dist 110 ∧ $1\bar{1}0$, 100° *Fr.* rdl, gran	$Al_2Ca_2H_2(SiO_4)_3$	G. ± 2.8. Decomp by HCl without gelatinizing. In closed tube yields water. BB fus with intumesc to blebby enamel-like glass. *A.* Calcite, Datolite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Epidote (Pistacite. Dimorphic with Zoisite)	vitreous pearly in part	grn, brn, yel, gry; seld red	6.5	Mcl *H.* clm, ac *S.* masv,insp, lam, ctg
Zoisite (Saussurite in part)	vitreous 010 pearly	gry, red, grn, wh	6.5	Orm *H.* clm, ac *S.* masv
Allanite (Orthite)	vitreous pearly in part	black, dark gray	6.5	Mcl *H.* clm, ac, tab *S.* masv,insp
Chondrodite (Humite) (Klinohumit)	vitreous to resinous	yellow, brown	6.5	Mcl *Humite* Orm *S.* masv, insp
Forsterite	vitreous	wh, yel, gry, grn	±6.5	Orm
Knebelite	unctuous	gry, blu, various	6.5	Orm
Rutile (Ilmenorutile)	adamantine	red, brown	6.5	Ttrg *H.* clm, ac cap *S.* masv, insp
Piedmontite (Manganehidot)	vitr, prly	rdsh, blk and brn	6.5	Mcl *H.* prsm, masv
Hortonolite	vitr to res	yel to dark yel grn	6.5	? Xlline
Cassiterite (Zinnerz)	adamantine resinous	blk, gry, brn Seld yel, red, wh	6.5	Ttrg *H.* clm, ac pyrl *S.* masv, insp

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. basal perf, 100 less so	$Al_2(Al.OH)Ca_2(SiO_4)_3$	G. 3.2–3.5. Partially decomp by HCl, but when first ignited gelatinizes with acid. In closed tube generally gives water. BB fus with intumesc to dark brn or blk mass, which is gen magn. Reacts for Fe and smts for Mn with fluxes. *A.* (1) In clefts of hornblendic rocks. (2) Chlorite slate. (3) The older limestone and magnetite beds. (4) In clefts and amygdaloids of melaphyre.
Clv. 010 perf *Fr.* stky	$Al_2(Al.OH)Ca_2(SiO_4)_3$	G. ± 3.2. Xls gen without terminal planes. Not decomp by acids. Previously ignited gelatinizes with HCl. BB swells up and fus to white blebby mass. *A.* Hornblende, Hessonite garnet, Epidote, Cyanite.
Fr. comp, cnch	$(Al,Ce,Fe)_2(Al.OH)(Ca,Fe)_2(SiO_4)_3$	G. 3–4.2. Most var gelatinize with HCl. Some var give water in closed tube. BB fus easily, and swells to a dark blebby magn glass. With fluxes reacts for iron. *A.* Magnetite, Hessonite. On granite syenite, trachyte. In the older limestones.
Clv. basal smts *Fr.* granular	$(Mg.OH)_2(Mg\ Fl)_4(Mg,Fe)_{12}(SiO_4)_5$	G. ± 3.1. Xls gen small and with many facets. Gelatinizes with acids. BB infus. Some var blken and then burn wh. Fused with mcrc, in open tube, reacts for F; with fluxes, reaction for Fe. *A.* Magnetite, Blende, Chalcopyrite, Galenite, Spinel, Amphibole, Biotite, Graphite. In deposits of the older limestones.
Fr. sub cnch	Mg_2SiO_4	G. 3.27.
Clv. 110	$(Fe,Mn,Mg)_2SiO_4$	G. 4. Trnsluc to opaque.
Clv. 100 perf 110 dist *Fr.* comp, gran	$Ti\ Ti\ O_4$	G. ± 4.2. BB infus. With mcrc clss bead, which, in RF, becomes vilt on cooling. *A.* (1) In the older slates. (2) In clefts of latter. Titanite, Adularia, Albite, Quartz, Chlorite. (3) In deposits of Apatite, Magnetite.
Clv. 001 perf 100 less so	$Ca_2(AlOH)(Mn,Al)_2(SiO_4)_3$	G. 3.4.
Fr. uneven	$(FeMg)SiO_3$	G. 3.91.
Clv. 100 perf 110 dist *Fr.* comp, gran, fine fib	$Sn\ O_2$	G. 6.4–7.1. Gen in twins. But slightly acted upon by acids. BB alone unaltered. With soda in RF, wh coat. *A.* (1) In the older slates and old eruptive rocks. (2) In tin veins. Arsenopyrite, Wolframite, Scheelite, Molybdenite, native Bismuth, Fluorite, Apatite, Lepidolite, Chlorite. (3) Deposits of Pyrite, Blende, etc. Aplome-Garnet, Pyroxene.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Bertrandite	vitr pearly	clss to slight yel	6.5	Orm *H.* tabular
Fibrolite Dimorphic with Cyanite	resinous, vitreous	gry, brn, grn	6.5	Orm *H.* ac, clm *S.* massive
Sillimanite	vitreous	colorless	6.5	Orm
Gadolinite	vitr to unct	blk, brn, grnsh	6.75	Mcl
Jadeite	sub vitr	apple to emld grn	6.75	Mcl
Peridot (Olivine, Chrysolite)	vitreous, resinous	grn, yel, brn	7	Orm *H.* short ac, short clm, tab *S.* masv, insp
Tridymite	vitr, 0 pearly	clss to wh	7	Hex *H.* tabular
Zunyite	vitreous	clss, clear	7	Ism *H.* tetr
Quartz (Silex, Kiesel)	vitr; on surf of frac res	all colors; gen wh and gry	7	Hex *H.* clm, ac, pyrl, seld rhdl *S.* masv,insp, lam, incr
Dumortierite	vitreous	bright smalt to grn blu	7	Orm *H.* fib to clm
Chalcedony (Flint. Varieties of Quartz)	on planes of frac glntg to ethy	all colors, and frequently many in the same specimen	7	Cryptoxlline *S.* rnfm, stal, glob, bot, nod, lam, incr
Vesuvianite (Idocrase)	res, partly vitr	brn, gry, yel; seld red	7	Ttrg *H.* clm, ac, tab, pyrl *S.* massive

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 110 perf	$H_2Be_4Si_2O_9$	G. 2.595 Trnsp Pyroelectric.
Clv. 010 perf *Fr.* fib, comp, spln	$Al(AlO)SiO_4$	G. ± 3.2: Not decomp by acids. BB infus. With Co sol gives a blue color. *A.* Cordierite, Zircon. In gneiss.
Clv. 010 very perf	Same as above	G. ± 3.2.
Fr. cnch to spln	H,Na,Ca,Be,Fe,Di,La, Ce,Y,Th,Si	G. 4.26.
Fr. spln	$NaAl(SiO_3)_2$	G. ± 3.4.
Clv. 010 dist, 100 less so *Fr.* gran, comp	$(Mg,Fe)_2SiO_4$	G. 3.34. Decomp and gelatinizes with HCl and H_2SO_4. BB whitens, but is infus. With fluxes gives reactions for Fe. Some var give reaction for Ti and Mn. (1) Occurs as a rock. (2) In basalt, gabbro, talc slate. *A.* Biotite, Bronzite, Hypersthene, Diallage, Garnet, and Magnetopyrite. *Not with Quartz.*
Clv. 101 faint *Fr.* cnch	SiO_2	G. 2.3.
Clv. octdl	$[Al(OH,F,Cl)_2]_6Al_2Si_3O_{12}$	G. 2.875. Transparent.
Clv. R very seld dist *Fr.* cnch, comp, spln, stky, fib, gran	SiO_2	G. ± 2.7. Gen horizontal striations on I. BB alone unaltered. With soda dissolves with effervesc. Unacted upon by mcrc. Sol only in HF. *A.* Very widely distributed.
Clv. 100 dist	$Al_6Si_2O_{13}$	G. 3.41. Trsp to Trsl.
Fr. in the large, even to cnch; in the small, fn spln	SiO_2	G. ± 2.7. BB, see Quartz. Either trsp or trsl. *A.* (1) In clefts and rounded cavities of Melaphyre. Quartz, Zeolites, Calcite. (2) In ore veins. (3) Deposits of Siderite and Limonite. (4) Flint in chalk.
Fr. stky, gran, comp, spln	$Al_{12}Ca_{24}(OH)_{10}Si_{20}O_{77}$	G. ± 3.4. Xls often show many facets. BB fus with intumesc to a grnsh or brnsh glass. With fluxes gives iron reac. After ignition completely decomp by HCl. *A.* In older limestones and deposits of Magnetite, Pyrite, Magnetopyrite, Blende, Galenite, Pyroxene, Aplome-Garnet, Chlorite, Biotite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Garnet (Carbunculus Varieties: Grossularite Ca-Al garn, Pyrope Mg-Al garn, Almandite Fe-Al garn, Spessartite Mn-Al garn, Andradite (or Aplome) Ca-Fe garn, Bredbergite Ca-Mg-Fe garn, Uwarowit Ca-Cr garn)	vitreous, resinous	in all colors *but blue;* most frequently red, brown, green, black	7	Ism *H.* dodecahedral, icositedrahedral *S.*
Axinite (Thumite)	vitr, partly adm	brown, gray	7	Trcl *H.* tabular *S.* massive
Tourmaline (Schörl Var I is brown Var II is red)	vitreous	in all colors; principally black, brown, and green	7	Hex *H.* rhdl, clm, ac *S.* masv, insp
Iolite (Cordierite, Dichroite)	vitreous, resinous	blue, grn, gry, brn	7	Orm *H.* columnar *S.* masv, insp
Boracite (Parasit, Stasfurtit) Dimorphic	vitreous adamantine	wh, gry, grnsh	7	Ism and Orm *H.* hxdl, dodl, tetr
Danburite	vitr to greasy	pl yel, brn, clss	7	Orm *H.* prsm
Andalusite (Chiastolite) Dimorphic with Cyanite	vitreous, resinous	rd, gry, brn	7	Orm *H.* clm, ac *S.* massive

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Fr. comp, spln, gran	Ca-Al G.–$Al_2Ca_3(SiO_4)_3$ Ca-Fe " $Fe_2Ca_3(SiO_4)_3$ Ca-Cr " $Ca_3Cr_2(SiO_4)_3$ Fe-Al " $Al_2Fe_3(SiO_4)_3$	G. 3.1–4.3. Most var fuse easily to light-brown or black glass. Almost all var react for Fe. The other reac vary with the bases. Almost all are decomp after ignition by HCl, and usually with sep of gelatinous silica. *A.* Almandite, Spessartite in the older slates and in granite. Melanite in basalt, nephelinite, Leucitite, etc. Aplome in deposits of Magnetite, Pyrite, Blende, Galenite, etc. Pyrope in Serpentine. Grossularite (Hessonite) in older limestones, imbedded in older slates, constituent of Eklogite; in deposits of Magnetite.
Clv. 010 distinct *Fr.* shelly	$H_2(Ca,Fe,Mn)_4$ $B\,O(Al,Fe)_3(SiO_4)_3$	G. ± 3.3. Not decomp by acids. Gelatinizes with HCl. Fus easily with intumesc, and imparts pl grn to fl, and fus to dk-grn to blk glass. With borax an amethyst-colored bead in O.F. Fused with $KHSO_4$ and fluorite on platinum wire gives grn fl. *A.* In clefts of Hornblende slate, diorite, etc. In deposits of Blende, Arsenopyrite, etc.
Fr. conchoidal, stalky, fib, gran	$(Mg,Fe,Na_2,Li_2,H_2$ $(AlO)_2)_9Si_4B_2O_{20}$	G. 2.9–3.3. Dichroic. Pyroelectric. Rubellite infus, but becomes paler. Not decomp by acids. BB most var fuse with intumesc, and give reac for Fe and Mn, and with mixture of $KHSO_4$ and CaF_2 strong reac for boracic acid. After fusion perfectly decomp by H_2SO_4 and gelatinizing with HCl. *A.* Almandite, Beryl, Topaz. In older slates. In and on granite.
Clv. 010 distinct 001, 100 indist *Fr.* compact	$(Al,Fe)_6Mg_3Si_8O_{28}$	G. ± 2.6. Only partially decomp by acids. BB loses transparency and fuses. *A.* Almandite, Schörl. In gneiss, granulite, granite.
Clv. of ism octl in traces *Fr.* conchoidal	$Mg_7Cl_2B_{16}O_{30}$	G. ± 3. Masv var gives water in closed tube. BB fus to white xline pearls, coloring fl grn. With Co sol assumes deep-pink color. Mixed with CaO and heated on coal gives fl deep-blue color. *A.* Gypsum, Anhydrite.
Clv. 001 indist *Fr.* unvn, sb cnch	$CaBe\,SiO_5$	G. ± 3. Trsp to Trsl.
Clv. 110 perfect $110 \wedge 1\bar{1}0$, 91° *Fr.* stalky, fibrous, compact, splintery	$Al(Al\,O)SiO_4$	G. ± 3.1. Weathering. BB infus. With Co sol, a blue color. Not decomp by acids. *A.* Almandite, Tourmaline, Rutile. In the older slates, granite.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Staurolite (Granatite, Staurotide)	vitreous	rdsh brn, blk-brn, blk	7.5	Orm *H.* clm, ac
Beryl (Emerald)	vitreous	grn, blue, wh, yel, red	7.5	Hex *H.* clm ac *S.* massive
Euclase	vitr to pearly	clss, grnsh, blush	7.5	Mcl *H.* prsm
Zircon (Hyacinth)	adamantine resinous	clss, and in all colors, especially brn, yel, and gry	7.5	Ttrg *H.* clm, ac, pyrl *S.* interspersed
Gahnite (Zinkspinell)	vitr greasy	gry, grn, yel, brn	7.75	Ism *H.* octl
Phenacite	vitreous	clss, yel, rose, brn	7.75	Hex *H.* rhdl
Chrysoberyl (Alexandrite)	vitreous, resinous	green, yellow	8	Orm *H.* thick tab, short clm, pyrl *S.* interspersed
Spinel (Picotite)	vitreous, resinous	blk, red, grn, blue, brn	8	Ism *H.* octahedral *S.* interspersed

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. 010 distinct	$(AlO)_4Fe(AlOH)(SiO_4)_2$	G. ± 3.6. Often in twins. BB infus, except the Mn var, which fuses to a black magn glass. With fluxes reacts for Fe and smts for Mn. Imperfectly decomp by H_2SO_4. *A.* Almandite, Cyanite. In mica slate.
Clv. bas dist *Fr.* stky	$Al_2Be_3(SiO_3)_6$	G. ± 2.7. BB unchanged or becomes clouded. Glass with borax, clear for beryl; fine grn for emld. Slowly sol with mcrc, without leaving siliceous skeleton. Undissolved by acids. *A.* Tourmaline, Topaz, Triphyline. In mica slate, chlorite slate, and in granite. In tin ore veins.
Clv. 010 *Fr.* conchoid	H Be Al Si O_5	G. 3.103. Trsp Tleschr Electric by friction.
Clv. 110 dist *Fr.* comp	$ZrSi\,O_4$	G. 4–4.7. Infus. The colorless var are unaltered; the red becomes clss. Not perceptibly attacked by mcrc. Powder is decomp by fus with soda on platinum wire, and if the product is dissolved in dilute HCl, gives the characteristic orange color with turmeric paper. *A.* In eruptive rocks, both the older granite, syenite, and the newer basalt. In clefts of the older slates with Diopside Garnet, Chlorite.
Clv. octl *Fr.* cnch	$(Zn,Fe)(AlO_2)_2$	G. 4.3.
Clv. $11\bar{2}0$ dist *Fr.* cnch	Be_2SiO_4	G. ± 3.
Fr. compact	Be Al_2O_4 or Be $(AlO_2)_2$	G. ± 3.7. Xls often seem hex. Insol in acids. BB alone unaltered. With soda the surf is merely rendered dull. With borax or mcrc fus with great difficulty. With Co sol the powder gives a bluh color. *A.* Beryl, Phenacite, Almandite, Tourmaline. In mica slate and granite.
Fr. compact	$MgAl_2O_4$ or $Mg(AlO_2)_2$	G. 3.5–4.9. Smts in twins. BB alone infus. Red var changes to brn or blk, and becomes opaque. On cooling becomes grn, then nearly clss, and finally resumes its red color. Slowly sol in borax and mcrc, with which it gives rdsh bead, becoming grn by cooling. Sol with difficulty in H_2SO_4. *A.* Pyroxene, Chondrodite, Biotite, Graphite. In the older limestones. In basalt and talc slate.

Name	Lustre	Color	Hardns	Crystal System Habit and Structure
Topaz (Topazius, Pyrophysalite, Physalite, Pycnite)	vitreous, adamantine, and on **0** pearly	yel, pl blue, wh, pl grn, pl red	8	Orm *H.* clm, ac *S.* insp, masv
Corundum (Ruby, Sapphire)	vitreous, resinous	blue, red, grn, gry, brn, wh	9	Hex *H.* clm, thick tab, pyrl, rhdl *S.* masv, insp
Diamond (Adamas)	adamantine	in all colors, most frequently wh, gry, yelsh, brnsh	10	Ism *H.* octl, dodl, hxdl *S.* masv, insp seld globular

Cleavage and Fracture	Chemical Formula	REMARKS Sp Gr, Reactions A = Associated Minerals
Clv. bas perf *Fr.* stalky	$Al(Al(F_2O))SiO_4$	G. ± 3.5. BB infus. Some var take a wine-yel or pink tinge when heated. Fused in open tube with merc gives reac for F. With Co sol the powder gives fine blue. Only partly attacked by H_2SO_4. *A.* In tourmaline slate, in and on granite. On tin ore deposits.
Clv. R dist basal dist *Fr.* gran, comp, spln	Al_2O_3	G. ± 4. BB unaltered. Slowly dissolved in borax and merc to a clear glass, which is clss when free from iron. Not acted upon by soda. Finely powdered mineral gives blue color with Co sol. Not acted upon by acids. Friction develops electricity. *A.* In independent deposits. Magnetite, Chlorite. In older limestones and granite. In basalt.
Clv. 111 hly perf	C	G. 3.5. Xls often rounded. Burns to CO_2. Is not acted upon by acids or alkalies. Almost always loose. In washings, with decomposed Peridot.

TABLE OF ELEMENTS

[The atomic weights are calculated on the basis of O = 16.]

Name	Symbol	Atomic Weight	State*	Discoverer	Date
Aluminum	Al	27.1	Solid	Woehler	1827
Antimony	Sb	120.2	"	Valentine	1460
Argon	A	39.9	Gas	Rayleigh and Ramsay	1895
Arsenic	As	75.0	Solid	Schroeder	1694
Barium	Ba	137.37	"	Davy	1808
Bismuth	Bi	208.0	"	Agricola	1529
Boron	B	11.0	"	Davy	1807
Bromine	Br	79.92	Liquid	Balard	1826
Cadmium	Cd	112.40	Solid	Stromeyer	1817
Caesium	Cs	132.81	"	Bunsen	1860
Calcium	Ca	40.09	"	Davy	1808
Carbon	C	12.00	"	Ancients	....
Cerium	Ce	140.25	"	Berz. and Hisinger	1803
Chlorine	Cl	35.46	Gas	Scheele	1774
Chromium	Cr	52.1	Solid	Vauquelin	1797
Cobalt	Co	58.97	"	Brandt	1733
Columbium	Cb	93.5	"	Hatchett	1803
Copper	Cu	63.57	"	Ancients	....
Dysprosium	Dy	162.5	"	.....	....
Erbium	Er	167.4	"	Mosander	1843
Europium	Eu	152.0	"	.....	....
Fluorine	F	19.0	Gas	Moissan	1886
Gadolinium	Gd	157.3	Solid	.....	....
Gallium	Ga	69.9	"	de Boisbaudran	1875
Germanium	Ge	72.5	"	Winkler	1886
Glucinum	Gl	9.1	"	Woehler	1828
Gold	Au	197.2	"	Ancients	....
Helium	He	4.0	Gas	Ramsay	1895
Hydrogen	H	1.008	"	Cavendish	1766
Indium	In	114.8	Solid	Reich and Richter	1863
Iodine	I	126.92	"	Courtois	1812
Iridium	Ir	193.1	"	Tennant	1804
Iron	Fe	55.85	"	Ancients	....
Krypton	Kr	81.8	Gas	Ramsey	1895
Lanthanum	La	139.0	Solid	Mosander	1839
Lead	Pb	207.10	"	Ancients	....
Lithium	Li	7.00	"	Davy	1818

*At ordinary temperatures.

Name	Symbol	Atomic Weight	State*	Discoverer	Date
Lutecium	Lu	174.0	Solid	.....	....
Magnesium	Mg	24.32	"	Davy	1808
Manganese	Mn	54.93	"	Gahn	1774
Mercury	Hg	200.0	Liquid	Ancients	....
Molybdenum	Mo	96.0	Solid	Hjelm	1782
Neodymium	Nd	144.3	"	.....	....
Neon	Ne	20.0	Gas	Ramsay	1895
Nickel	Ni	58.68	Solid	Cronstedt	1751
Nitrogen	N	14.01	Gas	Rutherford	1772
Osmium	Os	190.9	Solid	Tennant	1803
Oxygen	O	16.00	Gas	Priestley	1774
Palladium	Pd	106.7	Solid	Wollaston	1803
Phosphorus	P	31.0	"	Brandt	1669
Platinum	Pt	195.0	"	Wood	1741
Potassium	K	39.10	"	Davy	1807
Praseodymium	Pr	140.6	"	.....	....
Radium	Ra	226.4	"	Curie	1903
Rhodium	Rh	102.9	"	Wollaston	1803
Rubidium	Rb	85.45	"	Bunsen	1860
Ruthenium	Ru	101.7	"	Claus	1845
Samarium	Sa	150.4	"	de Boisbaudran	1888
Scandium	Sc	44.1	"	Nilson	1879
Selenium	Se	79.2	"	Berzelius	1817
Silicon	Si	28.3	"	Berzelius	1823
Silver	Ag	107.88	"	Ancients	....
Sodium	Na	23.00	"	Davy	1807
Strontium	Sr	87.62	"	Davy	1808
Sulphur	S	32.07	"	Ancients	....
Tantalum	Ta	181.0	"	Ekeberg	1802
Tellurium	Te	127.5	"	Klaproth	1798
Terbium	Tb	159.2	"	Mosander	1843
Thallium	Tl	204.0	"	Crookes	1861
Thorium	Th	232.42	"	Berzelius	1829
Thulium	Tm	168.5	"	Cleve	1879
Tin	Sn	119.0	"	Ancients	....
Titanium	Ti	48.1	"	Klaproth	1794
Tungsten	W	184.0	"	De Luyart	1786
Uranium	U	238.5	"	Péligot	1841
Vanadium	V	51.2	"	Sefstroem	1830
Xenon	Xe	128.0	Gas	Ramsay	1895
Ytterbium (Neoytterbium)	Yb	172.0	Solid	Marignac	1872
Yttrium	Y	89.0	"	Woehler (?)	1843
Zinc	Zn	65.7	"	Mentioned by Paracelsus	1540
Zirconium	Zr	90.6	"	Berzelius	1824

* At ordinary temperatures.

MOHS'S SCALE OF HARDNESS

DEGREE.	
1.	Talc.
2.	Gypsum or Halite.
3.	Calcite.
4.	Fluorite.
5.	Apatite (crystallized variety).
6.	Feldspar (Adularia).
7.	Quartz.
8.	Topaz.
9.	Corundum.
10.	Diamond.

SCALES OF FUSIBILITY

PLATTNER'S.

1. Such as fuse to a bead. (*a*) Easily. (*b*) With difficulty.
2. Such as fuse only on the edge. (*a*) Easily. (*b*) With difficulty.
3. Such as are infusible.

VON KOBELL'S.*

1. *Stibnite.*—Fusible in candle flame in coarse splinters.
2. *Natrolite.*—Fusible in candle flame in fine splinters. Easily fused before the blow-pipe in coarse fragments.
3. *Almandite,* or Iron Alumina Garnet.—Infusible in candle flame, quite fusible before the blow-pipe in coarse fragments.
4. *Actinolite.*—Fusibility less than Almandite and greater than No. 5; fusible in coarse splinters.
5. *Orthoclase.*—Fusible in fine splinters.
6. *Bronzite.*—Only rounded on the edges in very fine splinters.

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*This is the only scale referred to in the preceding pages where numbers expressing fusibilities are used.

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